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Use of Waterworks Land

IN this country the full possibilities of the joint use of land by waterworks and park departments and other interests have not been realized. What can be done in this respect was told in E. P. Goodrich's report on city planning before the recent convention of the American Waterworks Association. As illustrating one of the uses to which reservoir areas may be put he cited the case of the Lake Montebello area at Baltimore, which is utilized as a golf course by the Baltimore Country Club. This practice might be followed with advantage in other cities. Of course, lands in the vicinity of reservoirs should be carefully guarded to prevent the runoff of polluting matter into the water, but by turning the marginal lands into the fairways and greens of a golf course the territory is placed in use without danger to the water supply. Other cities should not be neglectful of the revenues which might be secured from putting their waterworks lands to work.

Quality in Concrete

NEW possibilities in specifying concrete are suggested in the paper by Cloyd M. Chapman, presented at the recent meeting of the American Society for Testing Materials, part of which will be found on page 50 of this issue. He would make strength tests the basis for fixing the proportions to be used. In the discussion, R. J. Wig, of the U. S. Bureau of Standards, stated that the government was working along the same lines, a fact quite clearly shown in the recently issued bulletin on the strength of concrete. One of the important advantages of the proposed specification, which would require continuous testing as the concrete goes into the structure, is the incentive which it would afford the contractor to produce the best possible concrete. With the knowledge that the product must show strength values not below a given limit, he would endeavor to develop methods for insuring uniform and satisfactory concrete without loss of time or efficiency. Thus, in addition to the manifest advantages of economical proportions with the commercially available aggregates, such a specification would be a powerful stimulus for the improvement of quality.

Federal Road Aid

TERMINATING years of agitation, Congress has passed a federal-aid road bill of such proportions as to satisfy for the present the insistent federal-aid advocates. There is little likelihood that the President will refuse to sign the measure, as the Secretary of Agriculture is known to be favorable to it. The bill, fortunately, follows the lines of that drawn up by the American Association of State Highway Officials, and pork-barrel features are consequently excluded. The apportionment of funds is on definite lines, based on state area, population and post-road mileage; the state must match dollar for dollar the government's money, and no payments are to be made from the national treasury until the Secretary of Agriculture has satisfied himself as to the quality of the work. Of special value is the provision that no further federal aid will be forthcoming for states and counties which fail to "properly maintain" the federal-aid roads already built. Much progress has been made in awakening engineers and communities to the need for proper maintenance. No argument, however, is quite so potent as that of the withholding of funds. After the government has followed this course of insisting upon proper maintenance for five years it is reasonably certain that the states and counties will have learned better than ever before the need for maintaining the roads once they are built. If this lesson can be well taught that alone might be adequate return to the taxpayers for the $75,000,000 expenditure that the measure authorizes. The inclusion of the clause is a tribute to the persuasive abilities of those who framed and pushed the bill.

How the Railroads Are Being Valued

EVER since the passage three years ago of the federal Valuation Act the Engineering Record has recognized the great importance of the valuation of the railroads, and has followed the developments much more closely than any other journal has done. The important valuation conferences have been "covered," and the "fundamental principles" have been discussed at length in the editorial pages. Readers of the Engineering Record know that it has disagreed emphatically with many of the popular theories, and that with certain exceptions it upholds the railroad view. Involved with these principles, and yet quite apart from them, are the problems connected with the actual work of evaluating 250,000 miles of railroad at a cost of more than $50,000,000. So gigantic and many-sided is the undertaking that it is difficult to describe or picture it comprehensively. In a series of articles, the first of which appears on page 43, Mr. Stark of this journal's staff presents some of the outstanding features. The first article reviews the organization of the work from the passage of the Valuation Act, and gives a bird's-eye view of the present activities of the Division of Valuation. The second article will go into the detail procedure of the inventory as handled in the Eastern District. In succeeding articles what some of the railroads are doing will be discussed. It should be recognized that the country is large, that a wide variety of conditions require a variety of treatment and that what is here recorded may not tally with the experiences of some of those engaged in the work. The author is simply offering snapshots taken from as many vantage points as possible, hoping that they will give those outside of the work a better conception of what is being done, and suggest to some of those in it better ways of doing it.

The Lowest-Bid Curse

"THAT it is false economy to award contracts to contractors who have not had the necessary experience or have not the required equipment or financial resources." This is one of the conclusions in the report of the Department of Conservation and Development of New Jersey. It is a conclusion drawn with regard to road construction, but of course it applies with equal force to all classes of construction. No, there is nothing new about the pronouncement; there is, however, every reason why it should be made because communities, laboring under the low-bid curse, continue daily to award contracts to those who do not even know how to bid, much less how to do the work on which the bid is made. This and other journals have deplored this condition of affairs for years; numberless solemn papers have been read on the subject. Now a state department which has made an exhaustive study of roadbuilding announces that the award of contracts to incompetent contractors (and they always think that they can do work for less than a well-equipped and responsible contractor will bid) is one of the principal causes of road failures. Must we go on forever doing something that everyone agrees is foolish and not economical? Or has the subject been talked about long enough, and the time for action arrived? If we are not yet willing to give officials enough liberty to choose the best bid, as distinguished from that which is merely the lowest, we have not progressed very far in improvement of the standards of public service and public servants.

Engineering Reminiscences

AS THE MEN who have made America's engineering works famous pass one by one to the great beyond, one cannot but regret that all too seldom they leave behind them reminiscences or autobiographies which might be an inspiration to future generations. Dr. Corthell, the latest to join "the innumerable throng," left, so far as is known, no such record. And what a fund of reminiscence, of tales of accomplishment, of anecdotes regarding the great men with whom he worked, has been lost. He could, and did, regale many a company with stories of Eads, of Morison, and of his own engineering experiences. It was almost prophetic that a guest in one of these companies early this year remarked that "before he [Dr. Corthell] goes he should write an autobiography." Probably the thought never occurred to Dr. Corthell. Too busy with his part in the world's work, ever attacking new problems, encouraging new enterprises, he thought little of the past and probably would have undervalued the influence of anything he might write. Corthell and Noble and Schneider—dozens of these engineering giants are gone. It is idle to bemoan the loss of the records they might have left. But there are still with us stalwarts who can record for us, and most graciously, the human side of the engineering of the last thirty or forty years. They will probably not do it of their own initiative. Their friends must urge them to the task.

Societies and Reminiscences

THE THOUGHT will occur to readers of the preceding note on engineering reminiscences that their publication may not easily be arranged for. Without a doubt many who have had interesting experiences have not the faculty of putting them in an attractive way. Further, the reputation of the writer must be very wide to make an autobiographical venture a commercial success. It is conceivable, in fact it is certain, that many reminiscences of great inspirational value would not find a commercial publisher. They need not, therefore, remain unwritten and unpublished. Is there here not an opportunity for "society service," a subject on which this journal has frequently dwelt in recent issues? Some of these proposed reminiscences would be of greater value to the profession than much of the inconsequential stuff which appears in society publications. The elimination of a few papers of this sort would make room for some "human" material. It is realized that the acceptance of such contributions would be a delicate matter—to refuse what was prosy and unsuitable without hurting the feelings of those who might offer them. But difficult matters are not to be shunned merely because they are difficult.

Student Inspection Trips

AN IMPORTANT and yet neglected educational opportunity is the student inspection trip to manufacturing plants, construction operations or to finished structures of unusual magnitude and interest. While most institutions make a few such trips yearly, too often the students fail to obtain the inspiration and knowledge which a little better planning and handling would bring. In an address before the Technical Publicity Association of New York City Professor Furman, of Stevens Institute of Technology, effectively presented the sources of waste in these trips and the ideal to which they should approximate.

He pointed out that incompetent guides, instead of the best-informed and most successful of the plant's engineers, are put in charge of the students. The biggest engineer in the plant should be persuaded to explain the meaning of the various operations and the inter-relation of parts to one another and to the final product. Lifelong impressions of the plant would thus be carried away by the young men, while the engineers themselves would be a source of inspiration to their neophyte brethren.

Furthermore, the number of students to one guide should be relatively small. Every man should be able to hear the explanations. In the confusion and noise of most manufacturing plants it is very difficult to hear, yet explanations are imperative if full benefit is to be derived.

The Engineering Record, which has often commended the co-operative plan of engineering education used by Dean Schneider at Cincinnati, makes the suggestion that more conservative educators can accomplish something, at least, along the same line by making greater use of student inspection trips. In the vicinity of our great cities there is a wealth of opportunity for visits to all kinds of engineering operations. Such trips should be largely increased in number and variety and should be given a fixed place in the curriculum. The students, moreover, should be required to submit reports to insure retention of the knowledge and inspiration gained.

A Difference of Opinion

A LETTER in a recent issue of the *Journal* of the Engineers' Society of Pennsylvania comments on that publication's policy of urging engineers to participate in civic affairs and to voice their views on public questions. With this policy the correspondent differs. He says: "In this age of specialization a thorough, careful man has time for few matters beyond his own profession. Specialization spells efficiency. We need go no further than the much-quoted example of Germany to show what specialization can do for industrial and economic development. This (the Engineer's Society of Pennsylvania) is a technical society, and it seems to me that the journal representing the society should be devoted to purely technical subjects."

As the readers of the Engineering Record know, it, too, has consistently advocated a larger participation by engineers in public affairs of an engineering character. That policy, it is glad to say, has been heartily indorsed, though here and there are found individuals who want a magazine whose sole theme is technical. A well-rounded service to the engineering profession demands that a journal have the welfare of the profession as a whole in mind. Certainly that welfare requires more than the mere equipment of the engineer with the latest technical information. It demands that he go upward and onward; that his ethical standards be raised; that his relations with his fellows be improved so that the uttermost in co-operation is possible; that his position before the public be ever more prominent, in order that he may influence the community to its own advantage through the material services which he and his structures can render. Surely it must be recognized, even by the most technical, that our civilization on its material side is the work of the engineer, and that the physical improvement in our environment has been a necessary prerequisite for our political, economic and social development.

To divorce oneself from the relations which will allow the profession still better to do its work for the improvement of the nation and the race is to shut the door of progress. We most heartily agree with the editors of the *Journal* when they dissent from their correspondent's view. Extreme specialization leads to narrowness and prevents the discharge of those larger duties which the engineer, as a citizen, owes the nation. It prevents him from making a contribution to the progress of the race, a privilege that every unselfish man heartily welcomes.

The New Cement Specifications

PROBABLY the most important action taken at the meeting of the American Society for Testing Materials in Atlantic City last week—so far, at least, as the readers of the Engineering Record are concerned—was the passage of the new cement specification to letter ballot, with the understanding that if adopted they are to become effective Jan. 1, 1917. As is generally known, there have been two standard cement specifications for many years—those of the government and of the American Society for Testing Materials. Attempts to harmonize them proved abortive. Finally a joint conference committee, on which the government, the American Society for Testing Materials and the American Society of Civil Engineers were represented, was appointed. This body has been working for several years, and the specifications evolved and now reported are the result. With the conference there has been working the very large committee on cement of the American Society for Testing Materials.

There is excellent promise that the new specifications will be adopted by the government. Its adoption by the American Society for Testing Materials is practically certain. As for the American Society of Civil Engineers, the action will be limited to the acceptance of the report by the board of direction. Very likely, then, we shall soon have only one standard cement specification. The principal change in favor of higher quality of cement is the increase of fineness from 75 to 78 per cent, for passage through the 200-mesh sieve. No change is made in the test for constancy of volume, the center around which the storm has raged in recent years. On the chief item of divergence between the two older specifications—the method of determining the time of setting—the new specifications are a compromise; either the Gillmore needles or the Vicat apparatus may be used.

While there may be rejoicing that the divergence in specifications will soon be of the past, the new requirements are only a slight improvement over the older ones. Cement chemists claim that the specifications go as far as present knowledge of cement permits. Be that as it may, one might have expected, from the travail and stress through which the conference and the committee have passed, that something more would have been produced. One is tempted to repeat the quotation, "The mountain has been in labor . . ." Nevertheless, the vote of fifty-five in favor of the specifications, with no negatives and only three refraining from voting, should be taken as evidence that under present conditions the reported specifications are the best that are commercially feasible.

Army Reorganization and the Engineer Officers' Reserve

SINCE the Army Reorganization Act went into effect July 1 the chief interest of technically trained men in the measure centers about the organization of the engineer section of the Officers' Reserve Corps, for which definite provision is made in the new legislation. When the tentative draft of the bill was prepared last year one of its most unfortunate clauses placed a limit of 45 years upon the age of an applicant for a reserve commission. In an editorial in the Engineering Record of Dec. 18, 1915, page 747, the undesirability of this feature as applied to the engineer reserve was pointed out. It would have excluded from service engineers, occupying important executive positions in civil life, who would be of invaluable aid to the War Department in the event of a national crisis. In the measure, as finally signed by President Wilson, it is stated specifically that the age limits for other branches of the service do not apply to the engineer section of the Officers' Reserve Corps.

For this revision the profession has to thank the members of its joint committee, representing five of the national engineering societies, who were quick to see and correct the fallacy of this feature of the bill when it was first prepared. The act, very wisely, does not attempt to specify in detail how the engineer section of the Officers' Reserve Corps shall be organized. This work has been left to the War Department, which is now formulating the plan of organization and will issue an invitation to engineers to apply for commissions as soon as the requirements for admission to the several grades between second lieutenant and major have been definitely determined.

As it now stands upon the statutes the act provides for an Officers' Reserve Corps consisting of sections corresponding to the various arms, staff corps and departments of the regular army. The President alone is authorized to commission reserve officers in all grades up to and including that of major. The commissions of reserve officers cover a five-year period and may be renewed in the same or higher grades for successive periods of five years. In time of actual or threatened hostilities reserve officers may be assigned to temporary duty with the regular army or as officers in volunteer organizations or at recruit depots. They are entitled to the pay and allowances of the corresponding grades in the regular service, with increase in pay for length of active service.

An important feature of the act makes provision for the instruction of officers of the reserve corps. They may be called upon each year for fifteen days' service in the field, where they will receive the benefit of guidance in practical work by regular army officers. Every army man who has addressed audiences of engineers on the subject of military training recently has emphasized the absolute necessity of field service rather than a mere perusal of text books. Of course this field instruction for reserve officers is contingent upon appropriations for this specific purpose. Certainly the money will be well spent in improving the efficiency of the engineer branch of the reserves, for the European War has demonstrated that technically trained men are needed, as never before, in military operations as they are carried on today.

For the purpose of securing an additional reserve of enlisted men for military service an Enlisted Reserve Corps also has been authorized.

The way is now open for mobilizing effectively the nation's technically trained men. It is safe to predict that when the War Department's call for the enrollment of reserve officers is made there will be a hearty response from the engineering profession.

Who Should Select the Pavements?

IT is quite customary to allow citizens to select the type of pavement to be laid in front of their property. The custom can be ascribed without doubt to the prevalence of that very excellent institution, the special-assessment system. The theory seems to be that since the citizens pay the bill, they should have the right to say what they shall buy. While there is reason back of the theory, the relation of the property holders to the purchase of a pavement is quite different from that of the normal purchaser to the things he buys. Taken generally, a buyer knows the wares he contemplates purchasing. He does not always possess the technical knowledge expected of large organizations. He will not buy a suit of clothes by specification as does the government in purchasing army uniforms. Nevertheless, he has some standard based on experience.

With pavements it is different. The average citizen pays no attention to the condition of the streets, though possibly the advent of the automobile requires that this statement be qualified. Even when he does notice them, he is not sufficiently familiar with traffic conditions and construction details to know why one pavement proves a success and another a failure. One might contend that the average citizen may be qualified to pass some sort of judgment on the type in use on his own street for a term of years. But even were this granted —which this journal does not—there would still be inability to judge of the merits of alternative types.

Were the citizen left to himself, to judge by his experience and by the data placed at his disposal by a competent city-engineering department, the results might not be so bad. Unfortunately, from the time a new pavement is proposed to the date of signing contracts he becomes the object of attack of the material salesmen. Intent only on getting their products used, these men urge the use of their materials, whether or not they are adapted to the particular conditions. Even an engineer has need for great steadiness to resist this selling assault. What hope, then, is there that the layman will pass a reliable judgment? The result is obvious. The salesman with the glibbest tongue, or the one who can win a group of influential citizens, will get his material used. The real merits of the case do not receive consideration. The pavement is bought on price—first cost—not on quality. Total cost is entirely lost sight of.

Every engineer engaged in city work can cite instances to show the pernicious influence of the pavement-material salesman. In a recent case four different types were being laid on adjoining streets, though all conditions, traffic included, were identical. There was no excuse for the difference. The engineers admitted it. The variable factors were the skill of the material salesman and the mentality of the property owners. In another case, where citizens decided upon an undesirable type of paving, an opposing paving interest, with the assistance of an engineer, asked the signers of the petition the reason for their choice. They had no reason, except that a representative of the paving company, accompanied by an influential citizen, had visited them and requested their approval. When the facts were laid before them they withdrew their signatures with as much alacrity as when they had given them.

Fortunately some cities are abandoning this objectionable method of pavement selection. One improvement, and a great one, consists in putting in the hands of the city engineer the power to designate two or three types from which a selection must be made. Even this, however, is a makeshift. Granted that for given traffic and other conditions, two or three types are equally satisfactory—which is obviously not true— the engineer would nevertheless be in a better position to make a selection than the layman.

Without a doubt the best method of procedure is to have the city engineer designate the type that must be used. His choice would be predicated on all the factors that should be considered — foundation conditions, traffic, ability of the district to stand the assessment, characteristics, cost, and life of various surfacings. If this be deemed an unwarranted inroad upon the right of the citizen to indicate for what his money should be spent, reference may be made to the conditions which obtain in connection with other municipal engineering works governed by the special-assessment system. The property holders are not consulted as to the design of the sewerage system or the width of streets.

Manifestly the course here advocated does not preclude considerations of the wishes and views of the citizens—they should be given a hearing. Their views, though, will be but one of the factors.

Abandonment of the present system is necessary before city paving in this country will be on a satisfactory basis.

Finish Deep Bridge Substructure, Designed to Reduce Work Under Water, Month Ahead of Time

Giant Driver for 138-Foot Piles, Large Mixer Boat and Removable Dams Handled by Floating Crane Used to Build, 105 Feet Below Low Water, Foundations on Which Pumping Averaged Less Than 18 Feet

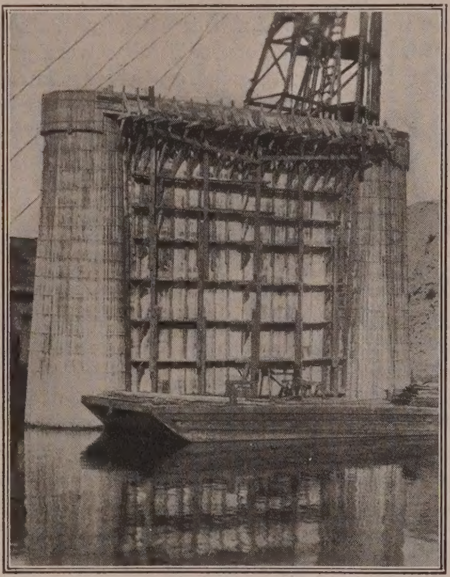
By FRANK M. CORTELYOU
Resident Engineer, Vancouver, Wash.

THE SUBSTRUCTURE of the Interstate bridge over the Columbia River at Portland, Ore., has been completed a month ahead of schedule in spite of six weeks' delay and notwithstanding that new construction problems had to be worked out. These problems were presented by a design which utilized the possibility of securing very long piles to concrete a large proportion of each pier base under water and save expensive construction, as was described on page 18 of the Engineering Record of July 3, 1915. The giant floating driver, overhanging the full width of the cofferdams and able to handle 138-ft. piles; removable cofferdams handled by a 50-ton floating crane and fitted in turn to the pier cribs, which remain in place, and a floating concrete plant which placed the 20-ft.-thick pier bases, the shafts rising 37 ft. above low water and the abutments back from the shore line, are among the construction features of the work. The pile driving was of unusual interest, an average penetration of 103 ft. being obtained under one pier and a large jet being plunged to full penetration in the sand bottom before setting each pile.

FIRST HIGHWAY BRIDGE ACROSS LOWER COLUMBIA

The structure is best known as a highway bridge because it is the first on which highway traffic will be carried across the lower Columbia River. Also it will remove the last obstacle to the Pacific Highway, which has been blocked only at this one point in the entire stretch from Mexico to Canada. In addition to highway traffic, however, the bridge will carry six lines of rails to provide double tracks for both broad and narrow gage electric cars. Work on the bridge was started in March, 1915, and the contracts require it to be ready for traffic on Oct. 31, 1916. The total length of the thirteen truss spans and one girder span over the main channel of the river shown in the accompanying drawing is increased, by long fills and the two girder bridges required to cross low land and sloughs on the Oregon side, to a total length of 4 1/3 miles.

The concrete bases of piers in the river proper were all built in open cribs on piles. The abutments consist of two shafts, each resting on a separate base connected at the top by a reinforced-concrete wall, which extends only a short distance below the bridge seat. Thus the horizontal thrust on the pier from the fill is greatly reduced and a considerable saving effected.



DUMB-BELL PIER SHAFT COMPLETED

The first work on the pier foundations was to excavate each pier site, removing enough material so that the sides could take a natural slope and still leave the desired clear area at the level of the pier base. While this excavation was in progress timber cribs (22 x 79 ft. in plan for piers 2 and 3, 16 x 57 ft. for piers 4 to 13 inclusive, and 15 x 54 ft. for pier 1) were built up to a height as great as could be floated in the depth of water available. As the excavation was finished at each pier the unfinished crib for that site was floated to place and its framing completed. A cofferdam of the same plan dimensions as the crib was then fitted on top and the two sunk until the crib rested on the bottom at the proper depth.

After the piles were driven inside this open caisson, the concrete base was poured through a tremie to within 2 ft. of the level at which the piles were to be cut off, forming the unusually thick pier base, with embedded piles, which is a feature of the design. The crib would then be pumped out, the piles cut off by hand and the remainder of the concrete placed in the open. Forms for the shaft were then built up above water level and the concrete completed to this point within the protection of the cofferdam. When the concreting was completed above water level the cofferdam was lifted off, ready to be used for the next pier.

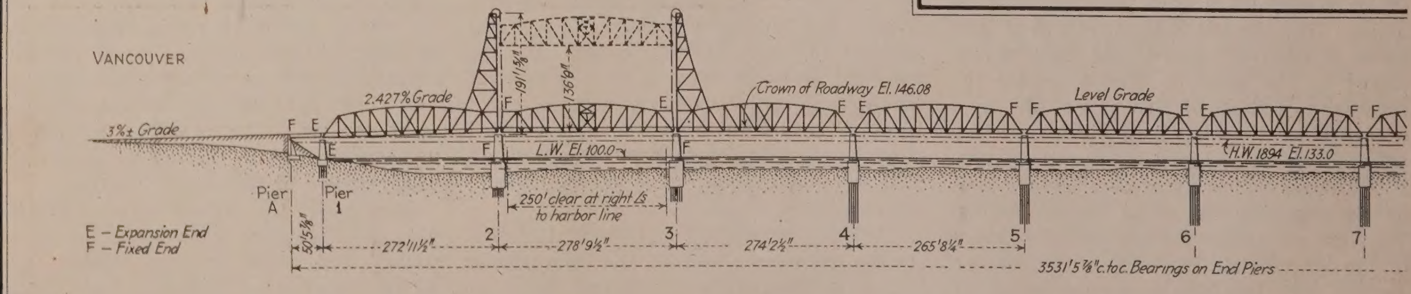
PIER EXCAVATION USED IN APPROACH FILL

Practically all the preliminary excavation was done with a dipper dredge having a 4-yd. bucket. It was not feasible to use a boom long enough to swing this material beyond the limits of the excavation, so it was loaded on barges and rehandled to a fill in one of the approaches. In order to dispose of this excavated material economically the substructure contractor took a subcontract for a portion of the approach fill that could be conveniently placed by this method.

The depth of the excavation at each pier was ordinarily about 20 ft., and from five to seven days of two 8-hr. shifts were required to complete it. The excavation for piers 2 and 3, which are to support a 272-ft. liftspan and the towers for raising it to a 175-ft. clearance above low water, was carried down about 25 ft. below river bottom. The excavation for each of these piers required about twenty 8-hr. shifts. The dipper dredge used for this work was able to excavate at a depth of about 48 ft. below the surface of the water.

CRIBS AND REMOVABLE CAISSONS

The timber cribs, filled with concrete up to the top of the pier bases, were left in place as part of the permanent construc-



IN COUNTRY WHERE PILES MORE THAN 100 FEET LONG ARE OBTAINABLE, DEEP PIERS FOR MAIN CHANNEL SPANS SHOWN WERE tion. The cofferdams used above this point were built in the same as the cribs, except that the thickness of the cofferdam timbers decreased with the height. These cofferdams were handled as units by a 50-ton floating derrick, which lifted them into place on top of the completed cribs and later removed them after the pier shaft had been carried above the water level. In removing several of these dams the dead lift approached the capacity of the crane. Three cofferdam units were built for piers 4 to 13 inclusive, and one cofferdam of a larger size was used for the two piers under the liftspan towers.

CRIBS SUSPENDED DURING CONSTRUCTION

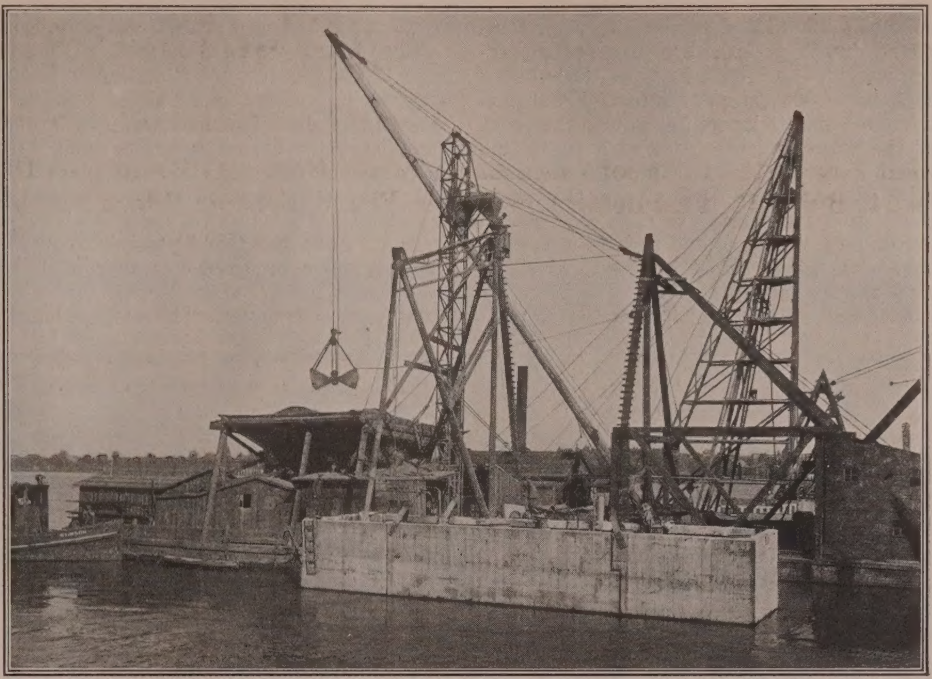
To facilitate handling the cofferdams it was found desirable, as with the cribs, to begin their construction near the shore and when partly completed to float them to deeper water to be built up to final height. At the point selected as shipyard, parallel rows of piles were driven, separated by a distance slightly greater than the pier width. Suspended from caps on these piles were two pairs of four-sheave tackles, which supported two crossbeams passing beneath the bottom timbers of the crib or cofferdam. At the desired stage the structure was lowered by the tackles until it floated.

In fastening the cofferdam to the crib, ten 1-in. rods were used, located at each corner of the crib and at the ends of each strut. The lower ends of these rods were U-shaped and attached by means of a bolt to a strap plate bolted to the crib. The tops of the rods passed through a 3-in. plank laid across the corner or along the sides of the cofferdam. The joint between crib and cofferdam was calked with oakum, which was then battened over to keep it in place. A 2 x 4 was also spiked around the lower edge of the cofferdam on the inside and to the top of the last course of the crib, this being possible, as the top crib timber was 2 in. thicker than the bottom of the cofferdam. During the placing of these rods and the calking of the joint the derrick which placed the cofferdam still held part of the weight, so as to prevent the crib and the cofferdam from overturning.

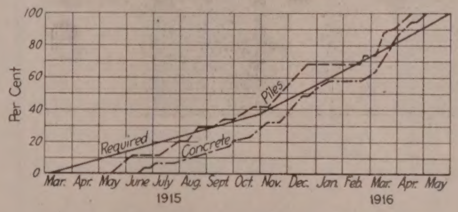
In order to sink the cribs, sand boxes were provided for weight by extending side timbers beyond the ends of the crib, laying a suitable floor and supporting it on inclined struts. The sides and ends were roughly boxed up to hold the material used for ballast. Usually very little digging had to be done when the cribs were lowered, as it was found that the original excavation did not rapidly fill up.

RIGGING TO PLACE CRIBS

Two methods were tried for guiding the cribs during sinking. The first method made use of four guide piles, one near each corner of the crib on the outside. These were square timbers, and each one passed through two steel straps fixed to the sides of the crib—one near the top and another near the bottom. Before driving these guide piles the dipper dredge was set just below the pier and firmly anchored by its spuds. By means of lines from the crib to the end of the dipper arm, the crib was shifted so as to be lined in by two transits on shore, and when satisfactorily located the guide piles were driven. As this method was not very successful, owing to the difficulty of holding the crib with the dredge and the time required to get the crib into line, it was abandoned in favor of a new plan.



FLOATING MIXER PLANT PLACED CONCRETE 40 FEET UNDER WATER TO 37 FEET ABOVE



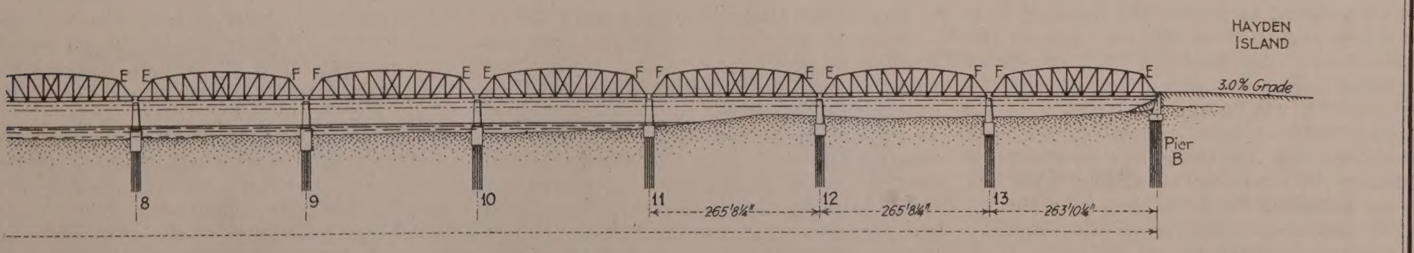
ACTUAL PROGRESS EXCEEDS REQUIREMENTS

Under the new plan dolphins were driven about 150 ft. above the center line of the bridge and 50 ft. on either side of the pier center line. The dipper dredge was then anchored by its spuds about 50 ft. below the downstream end of the crib and a line was run from each corner of the crib to the dredge, those from the upstream ends first passing through single-sheave blocks on the dolphins. The crib could then be easily handled and shifted by means of these lines and no further difficulty was experienced.

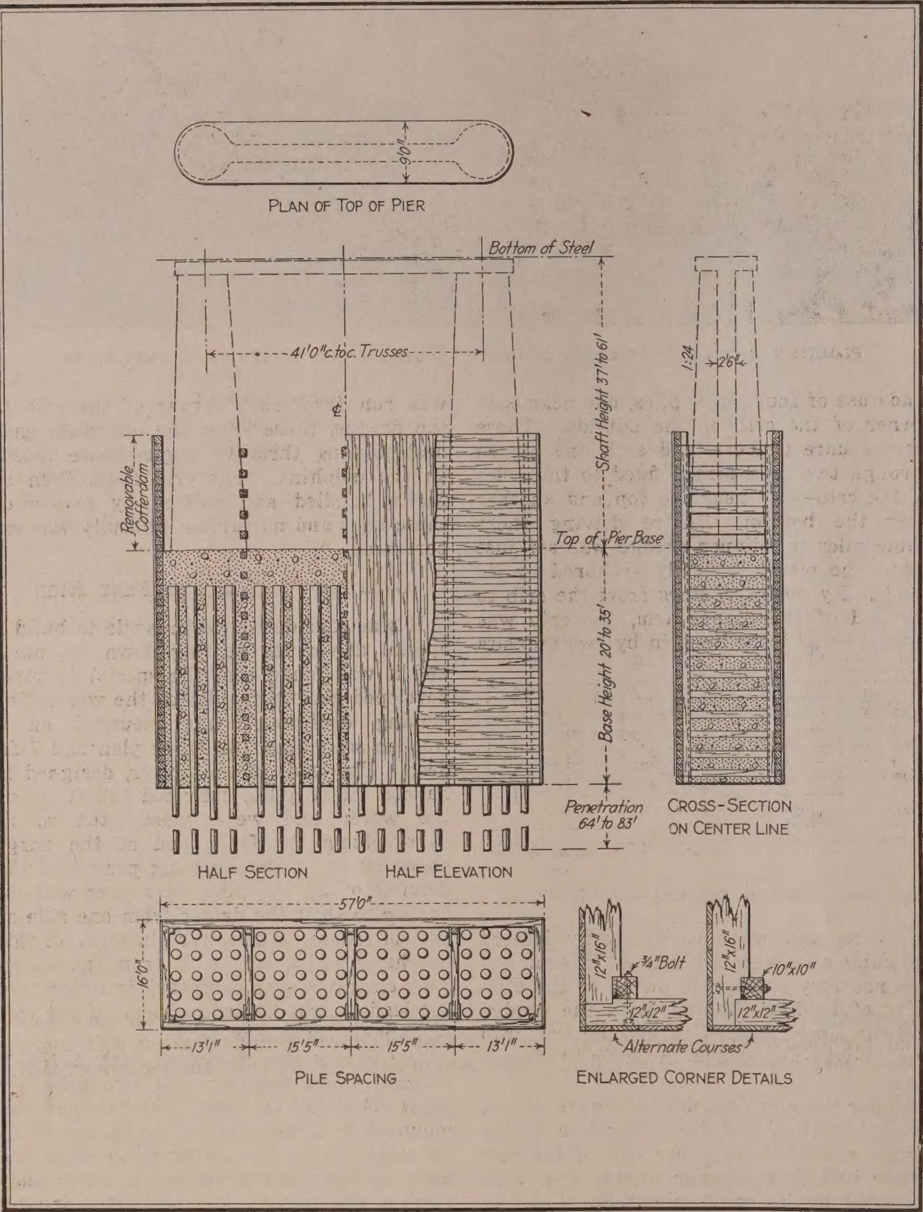
OVERHANG DRIVER 122 FEET HIGH

It was considered worth while to build a special driver for putting down the piles, and it was found that the special features developed greatly facilitated the work. The driving equipment was mounted on a wooden scow 32 x 100 ft. in plan and 7 ft. deep. The leads of the driver, designed to handle 138-ft. piles, extended 122 ft. above the water and were constructed so as to overhang the front end of the barge about 22 ft. This overhang permitted the driving of all the piles in a pier without having to shift the driver from one side of the cofferdam. The lower platform on this overhang was about 15 ft. from the water. This clearance was necessary in order that the leads might be swung clear of the cofferdam top at low water.

The driver was equipped with a No. 2 Vulcan steam hammer and two 4-in. jet pipes about 110 ft. long. The hammer was mounted in a steel frame, which served as an extension to the driver leads when the head of the pile got below the lower platform of the driver. This permitted driving until the head of the pile reached the water



BUILT BY EMBEDDING GREAT LENGTH OF PILING IN UNDER-WATER CONCRETE SEALS 20 FEET THICK, GREATLY REDUCING PUMPING surface. Two 12 x 18 x 10 x 12-in. compound duplex pumps were used for supplying water to the jets. Each of these had a capacity of 900 gal. per minute. From each pump a 7-in. discharge line ran to the front of the barge and there joined a 10-in. line running up the driver frame to a height of 68 ft. above the deck. From this point the water was carried to each side of the driver by a 7-in. line and then to a connection with the jet pipes by about 70 ft. of 4-in. rubber hose.



PERMANENT CRIB, REMOVABLE COFFERDAM AND DUMB-BELL SHAFT FEATURES OF SUBSTRUCTURE

Originally a 4-drum hoisting engine with 7 x 10-in. cylinders was installed. This was connected to handle the hammer line, pile line and each of the jet lines on the main drums. Later an 8 x 12-in. two-drum hoisting engine was added for handling the jets, as it was found that the original engine did not have enough power, and also that one engineer had considerable difficulty in attending to all four lines and to the pumps at the same time. An 800-hp. boiler supplied steam for the two engines, the hammer and the pumps.

The driving time shown in the table does not include the time spent in making repairs, except in the case of such minor repairs as broken water or steam hose. Most of the time lost at first was spent in correcting defects which developed in the rig after it was put in operation, but after the first three or four piers there was very little time lost. The material into which the piles were driven was fine sand with an occasional layer of clay. At piers 1, 2 and 3 the piles reached a hard, cemented gravel, which accounts for their small penetration. As it was found possible to secure the long piles required it was considered advisable to specify these lengths and eliminate follower troubles. The average length of piles used in piers 4 to 13 inclusive and in the Hayden Island abutment was 119.9 ft.

Before setting each pile the jets were put down their full length at the point where the pile was to be driven and were then quickly withdrawn, the pumps being stopped as soon as the jets started back. The pile was then picked up, set in the leads and dropped. The hammer was then lowered onto the pile and the jets again put down and worked up and down as long as the pile would go down under the weight of the hammer. Steam was then turned into the hammer and the pile driven to refusal with the jets working.

After some experience it was found that there was a decided advantage in first making a hole with the jets. The piles were ordinarily dropped for more than half of their penetration, and the weight of the hammer took them down still farther. The second lowering of the jets then secured an additional penetration, so that ordinarily the piles had to be driven only the last 10 or 15 ft. In many cases the jets took the piles down for the full penetration without requiring any hammering. It was found best to get the piles down as far as possible before starting the hammer, as the vibration seemed to make the sand settle around them and greatly to increase the difficulty of driving after the first 10 or 15 ft.

It was also found to be important to keep the piles straight, accurately located and driven vertically. As soon as a pile came in contact with one previously driven, excessive hammering was required for small additional penetration. Care was taken to keep the jets straight and with their lower ends close to the point of the pile, as it was found that if the jets got away from the pile the water was liable to follow up a pile previously driven, not only being of no help to the hammer, but actually involving the risk of lifting the other pile. This happened, fortunately without damage, in three or four cases with 120-ft. piles. It was also found to be necessary to keep the jets moving, as otherwise they tended to freeze in and cause considerable loss of time. The jets were not fastened to the piles, but each jet was held in place and guided by one man.

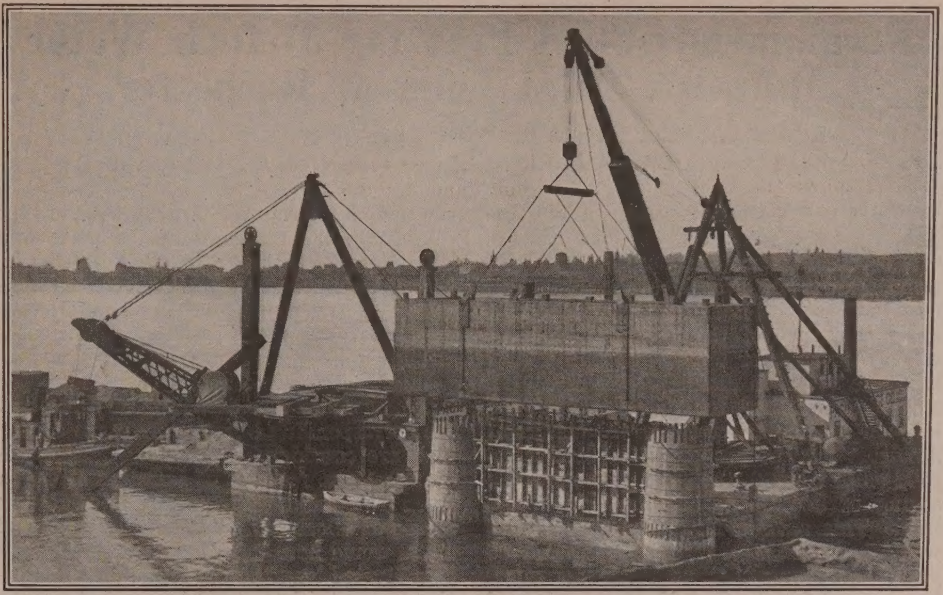
PENETRATION OF PILES AND TIME REQUIRED FOR DRIVING

Pier No.	Piles in pier	Penetration specified, ft.	Average penetration, ft.	Time required for driving. hr.
1	60	20	12.5	18
2	182	15	14.3	73
3	182	25	18.0	32
4	90	64	68.0	46
5	90	64	65.8	40
6	90	64	64.7	43
7	90	64	70.7	29
8	90	64	70.0	43
9	90	64	70.4	35
10	90	70	73.2	47
11	80	81	80.6	83
12	80	83	84.8	54
13	80	83	85.1	54
B	84	105	103.4	92

The jetting brought up considerable material, which had to be cleaned out of the crib before placing concrete. This was done with a hydraulic siphon operated by the pumps on the driver. The hose from one jet was connected to the siphon and the other jet was used to stir up the material. Ordinarily there was from 4 to 6 ft. of sand to be cleaned out of each crib.

FLEXIBLE FLOATING CONCRETE PLANT

The concreting plant was located on a 33 x 110-ft. barge equipped with sand and gravel hoppers and a 1-cu. yd. mixer. Sand and gravel were delivered from barges into the hoppers by a derrick boat with a clamshell bucket. Mounted on the barge was a steel elevator tower 90 ft. high, from which the concrete was dumped into the distributing hopper, passing thence through a chute into an 8-in. pipe, which delivered it directly to the forms or to a 10-in. tremie for deposit under water. The tremie was hung from a boom which could swing so as to deliver to any part of the crib, and was raised and lowered by the same engine as the hoist. The only trouble with the tremie occurred on the first day, when it was noticed that the material did not run through the pipe readily. The trouble was located in a joint between two sections of the pipe where a workman had failed to place a rubber gasket in a flanged coupling and the pipe was consequently not watertight.



FIFTY TONS OF REMOVABLE COFFERDAM BEING LIFTED OVER PARTLY FINISHED PIER SHAFT

LITTLE DIFFICULTY WITH PUMPING

The cribs were pumped out by means of a 10-in. pulsometer, which handled the work easily except in the case of the first crib, where a 10-in. centrifugal pump was also required. The first concrete was permitted to set at least 36 hr. before starting to pump. All the joints in the cofferdam, and in the crib from a point 6 ft. below the elevation at which the piles were cut off, were calked with oakum. As an additional precaution to prevent the water from coming up along the inside of the crib timbers, the fourth timber below the pile cutoff level was made 2 in. thinner than those above and below, thus keying the concrete of the seal into the crib. Most of the leakage into the cribs was through the joint between the crib and cofferdam. On being pumped out the large leaks in the cribs were calked from the inside, so that the leakage during the concreting of the remainder of the base was easily handled by a 3-in. pulsometer.

PUMPING HEAD ON CRIBS

Pier No.	Head, ft.
1	14.6
2	15.4
3	25.8
4	19.2
5	24.1
6	22.4
7	22.8
8	17.0
9	12.6
10	12.6
11	17.9
12	13.3
13	13.8

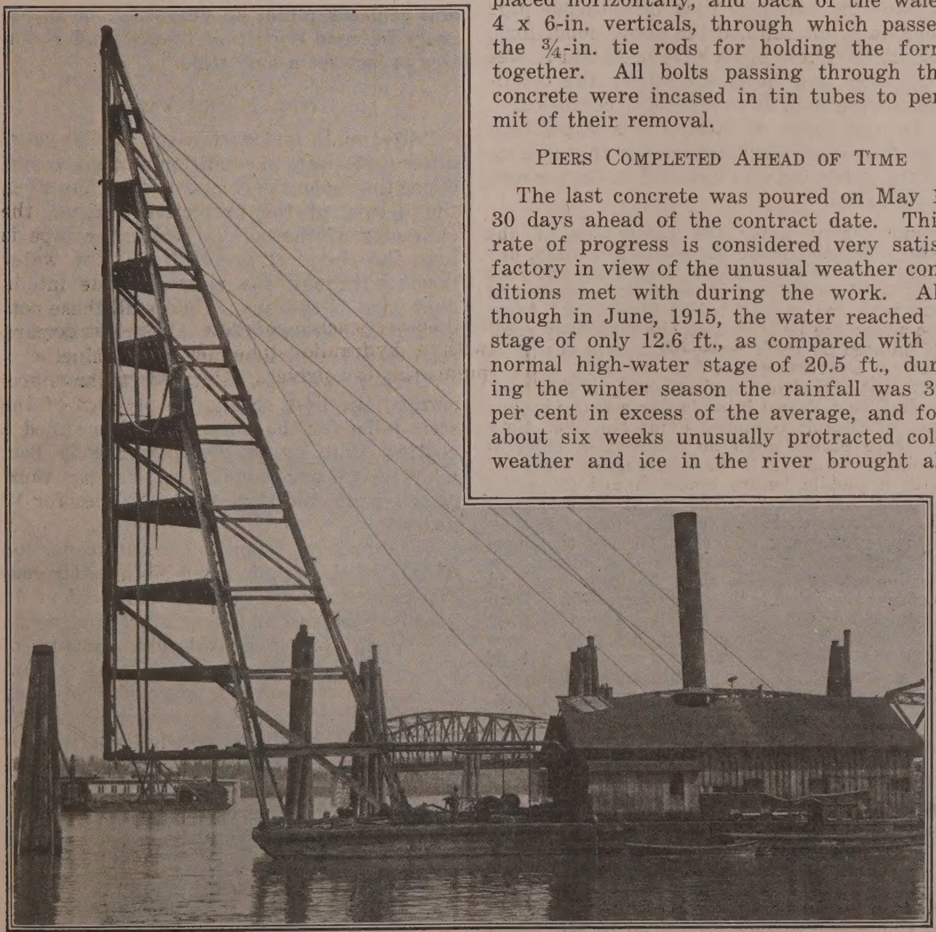
The accompanying table gives the head of water on each of the cribs after they were pumped out, the head being measured to a level 1 ft. below that at which piles were cut off.

For the forms for the tapering shafts of the pier 2-in. lumber was used, set vertically and with wedge-shaped pieces to care for the batter. These forms were tied across by ¾-in. horizontal rods spaced on 2-ft. centers. Wooden segmental shapes were set inside as spacers at 6-ft. intervals and removed as the concrete was carried up. The forms for the webs were all made of 1-in. shiplap, laid horizontally against vertical 2 x 6-in. studding spaced on 2-ft. centers. Back of the studding, and at about 4-ft. centers, 3 x 12-in. wales were placed horizontally, and back of the wales 4 x 6-in. verticals, through which passed the ¾-in. tie rods for holding the form together. All bolts passing through the concrete were incased in tin tubes to permit of their removal.

PIERS COMPLETED AHEAD OF TIME

The last concrete was poured on May 1, 30 days ahead of the contract date. This rate of progress is considered very satisfactory in view of the unusual weather conditions met with during the work. Although in June, 1915, the water reached a stage of only 12.6 ft., as compared with a normal high-water stage of 20.5 ft., during the winter season the rainfall was 30 per cent in excess of the average, and for about six weeks unusually protracted cold weather and ice in the river brought all work to a standstill. Since that time the progress made is particularly notable, over 30 per cent of the total number of piles (1376) and 40 per cent of the total concrete yardage (about 17,300 cu. yd.) having been placed within a period of two months.

Harrington, Howard & Ash (formerly Waddell & Harrington) of Kansas City, Mo., are the consulting engineers in charge of the design and construction, for whom the writer is resident engineer in charge. The Pacific Bridge Company, of Portland, built the substructure.



GIANT DRIVER OVERHUNG FULL WIDTH OF PIERS AND HANDLED 138-FOOT PILES

Quick Repair of Embankment Prevents Floods in Pomona, Cal.

By reconstructing an old embankment, known as the Fleming Dam, begun thirty years ago as a wall of loose boulders designed to keep the waters of the Santa Ana River from flooding Claremont and Pomona, Cal., the Pomona Valley Protective Association recently made the old work a stable and almost modern wall in a comparatively short time. A trench was excavated 3 ft. below the lowest point in the wash and a concrete wall was laid to a height of about 6 ft. A rock and gravel fill was constructed on the downstream side to a height of about 5 ft. more and of sufficient width at the top for a roadway. The face of this was covered with a layer of boulders and two widths of heavy wire fencing laid over the boulders. These were wired together and pieces of heavy galvanized wire, which later served to hold the entire mattress together, were placed 28 in. apart. On top of this layer of netting were put cobblestones 8 or 10 in. in diameter. The wire netting was then pulled up over this layer of rock, drawn taut with crowbars and securely tied to the netting below by the wires referred to, in much the same manner as tying a quilt. The upper edges of the netting were wired together. At distances of 30 ft. concrete was poured into the cobblestone apron, tying the whole mass together and yet making it sufficiently flexible to meet any change of ground level. At frequent intervals lengths of netting 15 or 20 ft. long, tied together to form a tube, were filled with boulders and placed to divert the water from the wall toward the center of the channel. The entire cost of construction was about $2.50 per foot.

Recommends Steel Pipe for 37-Inch Water Main 9⅔ Miles Long at Rochester

Edwin A. Fisher Favors Lock-Bar Line After Detail Analysis of Alternate Proposals for Steel and Cast Iron for Conduit 3

Basing his decision upon a detailed analysis of first cost of construction, cost of maintenance and durability of material, Edwin A. Fisher, consulting engineer to the city of Rochester, N. Y., has recommended that of the alternate bids received April 19 for a cast-iron and a steel pipe line 37 in. in diameter and 51,000 ft. long the one calling for a steel main of the lock-bar pipe be selected. In the matter of first cost for the proposed line, known locally as Conduit 3, the steel pipe showed a saving of $44,235 as compared with cast iron. This saving, Mr. Fisher calculated, would keep the steel pipe in repair for 38 years—assuming that no recoating would be required for the first 25 years—while at the same time a fund of more than $140,000 would be created. Mr. Fisher's findings are concurred in by John F. Skinner, principal assistant engineer, and Frederick P. Elwood, city engineer, in a report dated May 9, from which the following extracts have been taken:

KIND OF MATERIAL

Separate proposals were invited for furnishing the necessary 37-in. cast-iron pipe and special castings, and also for hauling and laying it. Alternative proposals were invited for furnishing, hauling and laying complete 37-in. lock-bar steel pipe for the same purpose. Three bids were received for furnishing the cast iron, ranging from $326,110 to $332,465, the lowest being that of the United States Cast Iron Pipe & Foundry Company, for $326,110. For hauling and laying cast-iron pipe, eleven bids were received, ranging from $130,155 to $165,810, the lowest bid being that of Desiderio & Sattler, amounting to $130,155. One bid for furnishing, hauling and laying 37-in. lock-bar steel pipe was received from the T. A. Gillespie Company of New York City. This bid amounted to $412,030 for the work complete.

The total cost of the cast-iron line, based upon the lowest bids received, is: For material, $326,110; for hauling and laying, etc., $130,155, or a total of $456,265.

The bid for a lock-bar steel pipe was $412,030, making a difference in cost in favor of the steel pipe of $44,235.

The total length of the line is 51,000 ft. The cast-iron bid is, therefore, $0.867 per lineal foot more than the lock-bar steel ($4,560 per mile), or about 10¾ per cent.

After citing a number of cases of cities using steel conduits Mr. Fisher states that the specifications for the new main at Rochester call for better material than was used in the city's Conduit 2, and at the same time conform to current metallurgical practice. He then discusses the relative merits of lock-bar and riveted pipe.

LOCK-BAR VS. RIVETED PIPE

A single riveted seam in tension, according to the report, can have but 55 per cent of the strength of the unpunched plate. A double riveted seam has about 70 per cent, whereas the lock-bar joint develops 100 per cent—the strength of the plate.

In the case of light heads, such as occur at the southern end of the conduit and in the section constructed in 1914, the limiting feature in the thickness of the plate was not its tensile strength, but its stiffness; ¼ in. was assumed as the least allowable thickness. The single-riveted longitudinal seam would, in general, have been sufficiently strong.

In the middle section of the conduit, or that now under consideration, the heads and the corresponding bursting pressure on the pipe are considerably greater. Hence, although ¼-in. metal is of sufficient strength when the longitudinal seam is made by means of a lock bar, additional thickness of metal would have been required in the case of a riveted longitudinal seam. Such addition to the thickness and consequent weight of the pipe would have materially increased the tonnage, and hence the cost of the work. It was therefore deemed advisable to omit the consideration of any steel plate except the lock bar.

As an insurance against weakening the plate by corrosion, 1/16 in. additional thickness has in all cases been added to the computed thickness required to withstand the internal water pressure.

COATING

An essential element in a steel pipe line as at present constructed, Mr. Fisher states, is a protective coating which will exclude moisture from contact with the plate. Experience during the last 25 years demonstrates, he believes, that bituminous pipe dips have not fulfilled the above conditions, especially where pipes have been laid in wet clay soils and in places where the conditions were such as to stimulate corrosion.

In the light of Rochester's experience the following specification for the coating of the steel pipe was included in the present proposals:

> Immediately after the fabrication of the steel pipes and while the plates are clean, dry and free from dirt, grease, loose scale and rust they shall be painted by hand both inside and out, with one coat of boiled linseed oil. After the pipes are delivered at the site, they shall be painted by hand, both inside and out, with Detroit Graphite Paint No. 501 and, after a sufficient period for the hardening of this coat, it shall be followed in a similar manner by one coat of Detroit Graphite Paint No. 106. Both of these paints shall be received in original packages and shall be thoroughly agitated with a paddle before being dipped from the original containers. The paint as delivered shall be used without the admixture of any oil dryer or thinning material. During the operation of coating and the period of drying or hardening, the pipes shall be kept dry and under cover from the weather. When both coats are sufficiently hard, or approximately one week after the second painting, the pipes shall be painted by hand with one coat of Trus-Con special paint. Pipes whose coating is unsatisfactory to the engineer will be rejected. Any painting of abraded places that is necessary after the coating has been applied shall be done with such paint, and in such manner and place as the engineer may direct. The cost of furnishing and applying the coating material and paint as aforesaid must be included in the prices bid per foot for pipe furnished and laid complete.

The careful performance and inspection of the work called for under this paragraph of the specifications, according to Mr. Fisher, is as important as any other provision, and must be strictly enforced.

The additional cost of coating the pipe as specified over the cost of the usual bituminous dip is estimated at $0.55 per lineal foot, or a total of $28,050 for the 51,000 ft.

CAST IRON AND STEEL

In comparing a 37-in. cast-iron water main for the portion of Conduit 3 in question with the same size lock-bar steel water main the report considers:

1. *Carrying Capacity.*—From the best information available it is believed that the two kinds of pipe are of equal capacity.

2. *Reduction of the Coefficient of Discharge by Age.*—Rochester's records show that the loss in delivery due to age is substantially the same for riveted steel as for cast iron.

3. *Leakage.*—Repeated measurements of the leakage of Conduit 2 show a very small leakage, well within the limits of good practice for cast-iron lines.

4. *Durability.*—Cast-iron pipe has given continuous service for long and indefinite periods—in Rochester's case for more than 43 years. Cases are cited of cast-iron pipe over 100 years old. It is not possible to set a definite limit to the life of a cast-iron water main.

Whether cast-iron pipe as now manufactured will have an equal life with pipe made 100 years ago might be questioned.

"Experience with wrought-iron pipe for a period of 40 years," according to the report, "and with steel for nearly 30 years, indicates very clearly that the composition of the metal, the character of the protective coating, as well as the intelligent care of the line, are factors which determine the serviceable life of wrought iron and steel mains. In our own case a wrought-iron main 3/16 in. thick, coated with asphalt and coal tar pitch, 43 years old, is apparently in good condition to-day, and promises to last for a long time.

STEEL MAINS VARY

"Steel main laid within the last 30 years differ materially in condition at a given age, depending upon the composition of the steel, the nature of the protective coating, the character of the soil in which the pipe is laid, the chemical properties of the water flowing through the main and the intelligent care of the line. Unless all these conditions are known and considered comparisons of different lines are of no value.

"In our own case, as stated, we have prescribed the best obtainable product of the steel mills for the purpose, and specified a coating that by long experience is best adapted to our conditions, having thoroughly protected Conduit 2 in places for 12 years.

"We believe, from a careful inspection of this coating, that it will be in better condition in three years more (the end of 15 years) than any of the original coating on this line. As no considerable amount of Conduit 2 required repairs or recoating until it was at least 10 years old, we may safely estimate that no recoating of the new line (Conduit 3) will be required for 25 years after construction. Assuming that Conduit 3 will require similar treatment in regard to recoating as has Conduit 2, the integrity of the portion of the line in question may be maintained for an indefinite period without cost to the Water Works Repair Fund, provided the difference in original cost amounts to a sum large enough to produce an income sufficient to pay for this work."

As regards cost of maintenance, Mr. Fisher submits the following figures: The cost of maintenance of a cast-iron line is generally small, due to leaks in lead joints at 12-ft. intervals, and infrequent, but sometimes serious, breaks in the metal. The cost of maintenance of a properly constructed cast-iron line for the first 25 years, we believe, will be fully equal to that of a lock-bar steel line constructed as herein described, after which the maintenance of a steel line, due to recoating, will much exceed that of the cast iron.

The portion of Conduit 3 in question is 37½ per cent of the total length of Conduit 2, and the average condition relative to cost of recoating similar. The cost of recoating this portion may therefore be taken at 37½ per cent of the total cost.

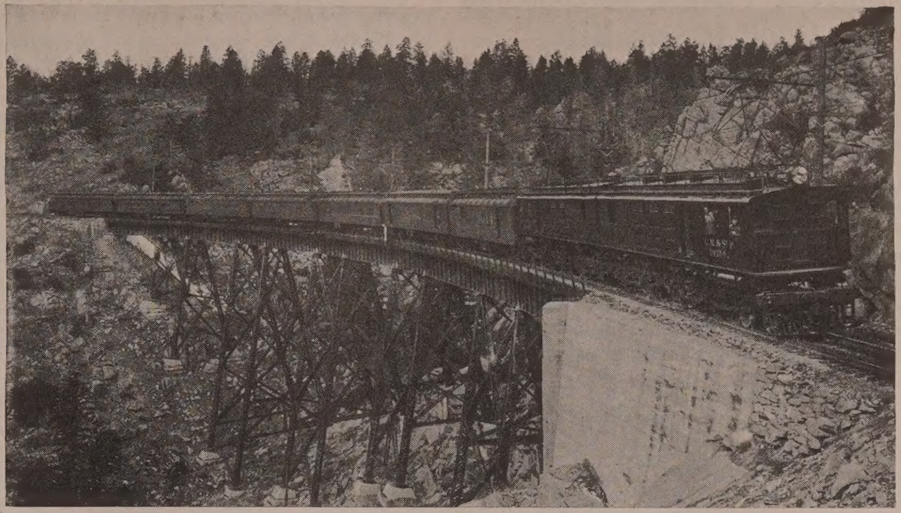
COST OF RECOATING

The amount expended in recoating the total length of Conduit 2, as per table prepared by Mr. Skinner, was for 13 years:

From 1903 to 1915 inclusive	$122,851.91
Or an everage of, per year	9,450.15
37½% of which is	3,496.55
The total cost of $122,851.91 may be subdivided as follows:	
For the first 5 years it was	$21,762.62
An average of, per year	4,352.53
37½% of which is, per year	1,632.20
For the next 8 years it was	101,089.18
An average of, per year	12,636.12
37½% of which is, per year	4,738.54

It has been assumed that no recoating would be required for the first 25 years and that an average of $1,632.20 per year would be expended the next five years.

Steel is $44,235 less than cast iron:	
$44,235 at 4% for (25 + 5) 30 years	$143,471.80
Less cost of recoating for 5 years (average per year $1,632.20)	8,840.52
Net sum remaining for future maintenance after 1946	$134,631.28
$134,631.28 at 4% for 8 years amounts to	184,252.33
Recoating for the next succeeding 8-year period, based upon the repairs of Conduit 2 for the last 8 years, would cost $4,738.54 per year or, accumulating at 4%, it would amount to	43,662.00
Deducting this from the above, we will have left in the year 1954	$140,590.33
Which at 4% interest will yield in perpetuity an annual maintenance fund of $5,623.61, while at all times after 1954 the principal sum of $140,590.33 will still be available.	


SINGLE ELECTRIC UNIT HANDLES SEVEN AND EIGHT COACHES ON 2-PER CENT GRADES

The foregoing $5,623.61, at the rate of $3.08 per lineal foot, will recoat 1826 ft. of conduit per year, or 3.58 per cent of this section, which is about 25 per cent more than the average rate of recoating of Conduit 2 for the last 8 years. It will therefore be seen that if the conduit is constructed of steel, the present saving of $44,235 will keep it in repair for the next 38 years, while at the same time a fund of over $140,000 will have been created for future use.

In view of the foregoing statements and of the conditions on this portion of the line, Mr. Fisher is of the opinion that the adoption of the steel conduit, with the saving of $44,235 at this time, will not entail unwarranted expense upon a future generation. He therefore recommends that the contract be awarded to the lowest bidder for steel pipe.

Advantages of St. Paul Electrification Show

Six Months of Electric Operation Demonstrate That Greater Tonnages Can Be Handled at Higher Speeds

ELECTRIC operation of the Rocky Mountain division of the Chicago, Milwaukee & St. Paul Railway has now undergone a six months' trial, and certain advantages appear to have been demonstrated. One of these is a material reduction in running time. On one 21-mile 2-per cent grade alone the time for passenger trains has been reduced from 1 hr. 5 min. to approximately 40 min. In the freight service it has been found that where steam locomotives have required from 10 to 12 hr. to make 115 miles, electric locomotives can meet a schedule of from 7 to 8 hr. for the same distance.

BUTTE, ANACONDA & PACIFIC ORE TRAIN ON UPPER LEVEL; ST. PAUL FREIGHT ON LOWER

The capacity of the new locomotives has been thoroughly tested. Trains of 3000 tons have been hauled east and 2800 tons west, a helper being used on the heavy grades. On some of the runs, where the grades are less than 1 per cent, trains of as many as 130 cars and as heavy as 4000 tons have been hauled by a single locomotive. It has been shown that much heavier trains can be hauled with the electric locomotives than by steam, and furthermore the capabilities of the electric equipment are not impaired by bad weather. During a series of record-breaking temperatures last December, Mallet engines were frozen up at several points and were rescued, with their trains, by electric locomotives.

Through passenger trains of 650 tons are hauled 220 miles by a single electric locomotive. Steam operation required a change of engines midway. Local passenger trains are handled by a half unit.

REGENERATING BRAKING

The regenerative braking has proved an easy solution to a difficult problem on the long mountain grades. Electric freight trains usually descend the maximum grades at 17 miles per hour, but half that speed can be maintained if desired. In case there are no other trains between the substations, to absorb the power generated by a descending train, the power passes through the substation machinery and is readily absorbed by the extensive system of the power company.

There are forty-four electric locomotives on the division—twelve passenger, thirty freight and two switching. They operate on the 3000-volt direct-current system, being the first to use so high a direct-current potential. (See the Engineering Record of Nov. 28, 1914, page 581, and that of Oct. 23, 1915, page 518.)

The foregoing information and illustrations are taken from an advance copy of a bulletin, "An Epoch in Railway Electrification," about to be issued by the General Electric Company, builder of the St. Paul locomotives.

Congress Passes $85,000,000 Good-Roads Bill

Measure Approved by Both Houses Last Week Has Been Submitted to President Wilson for Signature

ON JUNE 28 the good-roads bill agreed on in conference between the representatives of the House of Representatives and the Senate was passed by both houses and sent to the President for his signature. It is known that the Secretary of Agriculture has approved the bill, and there is little doubt that before this number of the Engineering Record reaches its readers the measure will have become law. The bill appropriates a total of $85,000,000 of federal money to be spent during five years. Of the total, $5,000,000 is made available for the fiscal year ending June 30, 1917, and $10,000,000, $15,000,000, $20,000,000 and $25,000,000 respectively for the succeeding years.

The states contribute an amount equal to that paid by the national government, though the federal payment may not exceed $10,000 per mile, exclusive of the cost of bridges of more than 20-ft. clear span. The basis of distribution is as follows: One-third in the ratio which the area of each state bears to the total area of all the states; one-third in the ratio of state population; one-third in the ratio which the state mileage of rural-delivery routes bears to the total mileage of such routes.

The appropriations detailed in the foregoing account for $75,000,000. The remaining $10,000,000 is to be expended for the development of the resources of the national forests; but this is to be entirely repaid to the government by crediting to the highway fund 10 per cent of all revenues from the forests until the total is made up.

The main appropriation is to be expended through state highway departments. Notification will be given them annually of the amount available for appropriation. They will then file with the Secretary of Agriculture "project statements" setting forth the work that is proposed in order to get the appropriation. If the project be approved, the state highway department will furnish the Secretary with surveys, plans, specifications and estimates. These in turn must be approved. The bill provides that federal money may be spent only on projects that are "substantial in character." Items for engineering, inspection and unforeseen contingencies shall not exceed 10 per cent of the total estimated cost of the work. If approved, payment on the project shall not be made until the Secretary has satisfied himself that the road has been properly constructed in accordance with the plans and specifications. Provision is made for partial payments as the work progresses.

The government's administration charges shall not exceed 3 per cent of the appropriation, and the estimated amount is to be deducted before the distribution by states is determined.

A very important provision insures proper maintenance of the federal-aid roads, at least during the effective life of the present measure. The states, or their legal subdivisions charged with maintenance, must maintain the roads. If any road is not properly maintained, "the Secretary of Agriculture will so notify the state highway department. If within four months of the receipt of the notice the road has not been put in a proper condition, then the Secretary must refuse to approve any project for road construction in that state, or in the subdivision responsible for the neglect, until the road is in satisfactory condition."

MAXIMUM ALLOTMENT OF ROAD-BUILDING FUNDS TO STATES DURING ANY FISCAL YEAR

State	Population			Rural free delivery		Star routes		Per cent of total miles of R. F. D. and star routes	Amount	Specific amount	Total amount of aid to each state
	Population	Per cent of total population	Amount	Number of routes	Aggregate length of routes miles	Number of routes	Aggregate length of routes miles				
Alabama	2,138,093	2.34	$255,996	1,065	25,845	251	2,589.09	2.36	$258,184	$65,000	$579,180
Arizona	240,354	.22	24,068	28	677	88	2,391.73	.26	28,444	65,000	117,512
Arkansas	1,574,449	1.72	188,168	558	13,366	520	6,069.38	1.62	117,228	65,000	430,396
California	2,377,549	2.60	284,440	408	9,553	396	7,564.85	1.42	155,348	65,000	504,788
Colorado	799,024	.87	95,178	207	5,472	271	4,724.00	.85	92,990	65,000	253,168
Connecticut	1,114,756	1.22	133,468	281	6,219	65	359.06	.55	60,170	65,000	258,638
Delaware	202,322	.22	24,068	58	1,509	12	58.71	.13	14,222	65,000	103,290
Florida	752,619	.82	89,708	233	5,546	176	1,716.59	.60	65,640	65,000	220,348
Georgia	2,609,121	2.85	311,790	1,493	36,610	145	1,381.43	3.16	345,704	65,000	722,494
Idaho	325,594	.36	39,384	162	4,061	155	3,161.62	.60	65,640	65,000	170,024
Illinois	5,638,591	6.16	673,904	2,844	68,979	80	717.77	5.79	633,426	65,000	1,372,330
Indiana	2,700,876	2.94	321,636	2,072	50,774	90	733.88	4.28	468,232	65,000	854,868
Iowa	2,224,721	2.42	264,748	2,116	55,929	36	275.73	4.68	511,992	65,000	841,740
Kansas	1,690,949	1.84	201,296	1,859	50,838	123	2,058.30	4.40	481,360	65,000	747,656
Kentucky	2,289,905	2.50	273,500	800	18,765	786	7,843.45	2.21	241,774	65,000	580,274
Louisiana	1,656,388	1.81	198,014	275	6,504	283	2,492.44	.75	82,050	65,000	345,064
Maine	742,371	.81	88,614	478	10,970	288	2,561.62	1.12	122,528	65,000	276,142
Maryland	1,295,346	1.41	154,254	422	9,698	156	1,210.58	.91	99,554	65,000	318,808
Massachusetts	3,366,416	3.67	401,498	278	6,684	140	862.60	.63	68,922	65,000	535,420
Michigan	2,810,173	3.06	334,764	1,759	48,046	150	1,551.58	4.12	450,728	65,000	850,492
Minnesota	2,075,708	2.27	248,338	1,581	43,676	190	2,560.63	3.84	420,096	65,000	733,434
Mississippi	1,797,114	1.96	214,424	894	21,512	236	2,462.41	1.99	217,706	65,000	497,130
Missouri	3,293,335	3.59	392,746	2,166	51,455	452	5,310.99	4.72	516,368	65,000	974,114
Montana	376,053	.41	44,854	94	2,506	262	6,541.00	.76	83,144	65,000	192,998
Nebraska	1,192,214	1.30	142,220	1,086	29,233	211	4,554.27	2.81	307,414	65,000	514,634
Nevada	81,875	.09	9,846	4	85	81	2,807.60	.24	26,256	65,000	101,102
New Hampshire	403,572	.47	51,418	246	5,564	122	909.47	.54	59,076	65,000	175,494
New Jersey	2,537,167	2.77	303,038	311	7,149	110	553.09	.64	70,016	65,000	438,054
New Mexico	327,301	.36	39,384	28	801	218	4,860.61	.47	51,418	65,000	155,802
New York	9,113,614	9.94	1,087,436	1,949	44,970	486	3,648.97	4.04	441,976	65,000	1,594,412
North Carolina	2,206,287	2.41	263,654	1,378	31,961	396	4,042.54	2.99	327,106	65,000	655,760
North Dakota	577,056	.63	68,922	630	18,401	163	2,608.55	1.75	191,450	65,000	325,372
Ohio	4,767,121	5.21	569,974	2,545	60,917	149	1,041.16	5.15	563,410	65,000	1,198,384
Oklahoma	1,657,155	1.81	198,014	957	25,504	288	4,125.00	2.46	269,124	65,000	532,138
Oregon	672,765	.73	79,862	253	6,187	248	5,294.43	.95	103,930	65,000	248,792
Pennsylvania	7,655,111	8.36	914,584	1,906	49,963	562	3,962.82	4.48	490,112	65,000	1,469,696
Rhode Island	542,610	.59	64,546	49	996	18	87.61	.09	9,846	65,000	139,392
South Carolina	1,515,400	1.65	180,510	860	20,420	114	1,177.96	1.80	196,920	65,000	442,430
South Dakota	583,888	.64	70,016	621	18,271	190	4,021.74	1.85	202,390	65,000	337,406
Tennessee	2,184,789	2.38	260,372	1,611	38,313	207	2,276.41	3.37	368,678	65,000	694,050
Texas	3,896,542	4.25	464,950	2,019	49,251	628	10,179.40	4.94	540,436	65,000	1,070,386
Utah	373,351	.41	44,854	55	1,235	113	2,541.11	.31	33,914	65,000	143,768
Vermont	355,956	.39	42,666	343	7,610	137	1,166.77	.73	79,862	65,000	187,528
Virginia	2,061,612	2.25	246,150	1,101	24,557	666	6,295.00	2.56	280,064	65,000	591,214
Washington	1,141,990	1.25	136,750	349	8,539	173	2,450.77	.91	99,554	65,000	301,304
West Virginia	1,221,119	1.33	145,502	420	9,403	475	4,946.22	1.19	130,186	65,000	340,688
Wisconsin	2,333,860	2.55	278,970	1,691	41,717	145	1,510.27	3.59	392,746	65,000	736,716
Wyoming	145,965	.16	17,504	21	592	157	4,137.03	.39	42,666	65,000	125,170
Total	91,641,197	100	$10,940,000	42,567	1,056,897	11,430	147,365.50	100	$10,940,000	$3,120,000	$25,000,000

Province of Quebec Encourages Water-Power Developments

THE PROVINCE of Quebec, Canada, with its long-term leases, does not regulate the rates of power companies and their charges to consumers. It makes no conditions in its leases as to what is to become of the leased property and the improvements at the end of the leasing period, the theory being that the courts may safely be relied upon to be fair both to public and to private interests when the time comes to take over such properties, if they are to be taken over.

The aim of the provincial officials is to invite and encourage the investment of private capital. The hydraulic service of the Department of Lands and Forests surveys and makes reports on the potential water powers in the province, exploits them and seeks in legitimate ways to encourage development. The results of its surveys and investigations are public property.

When the investigation of a given site is completed, the province determines the reasonable value of the power privilege and offers the lease at auction, the award going to the highest bidder whose offer exceeds the upset price fixed by the government officials. Under this law Quebec has leased twenty-four power sites, ranging in size from 38 to 180,000 hp., since the present law went into operation in 1906. The total development under the leases aggregates 480,598 hp.

Recapture is ignored in the Quebec leases, with the idea on the part of the government officials that the question as to compensation and valuation should be left open to be settled by the courts in accordance with the policies which may prevail in the distant future when leases expire.

The development at Cedars Rapids in the St. Lawrence River (see the Engineering Record of Oct. 25, 1913, page 461) was made under such terms, and that instance may be cited as typical, although it is the largest single development under the Quebec law. It is capable of developing 180,000 hp., and was leased in 1910 for a term of 99 years. The power company, under its lease, is to pay an annual rental of $600 from the date of the signing of the lease, with additional yearly charges on the quantity of 24-hour electric horsepower development, as follows: For the first 50,000 hp., 15 cents; on the next 25,000 hp., 20 cents, and on any quantity over 75,000 hp., 30 cents. At the expiration of each thirty-year period the government reserves the right to advance the rate.

Iron-Ore Production in 1915 14,000,000 Tons Greater Than in 1914

The iron ore mined in the United States in 1915 reached a total of 55,526,490 gross tons, the greatest output made in any year except 1910 and 1913, according to figures of the U. S. Geological Survey. The shipments totaled 55,493,100 gross tons, at a value of $101,288,984. The quantity mined was an increase of 14,000,000 tons over the output in 1914. The average value per ton in 1915 was $1.83, as compared with $1.81 in 1914. It is estimated that in 1916 the production of iron ore from the Lake Superior district alone will possibly be 60,000,000 tons, and there will probably be an increase in price of 70 to 75 cents a ton for this grade of ore.

What the Government Valuation Division Is Doing and How the Work Is Handled

Organization Built Up from Bottom and Many Problems New to Valuation Met—Sixty Roadway Parties Now Covering 4000 Miles of Road Monthly

By C. W. STARK
Associate Editor, Engineering Record

THREE YEARS AGO Congress passed the Valuation Act—an act which imposed on the Interstate Commerce Commission a task that dwarfed everything ever done before in the way of valuation. Other valuations of carriers had been made, usually for specific purposes; important though they were, each stood on its own merits, and established no general precedents; each was used once and virtually set aside. Some were for taxation purposes, and the railroads were not overanxious to have every hidden item recorded. In other cases, where rates were at issue, the railroads had fought hard for every item, but the state commissions or other bodies that opposed them had no standardized rules bearing on the subject, consequently the establishment of a point in one case did not insure its acceptance in the next. The federal act intimates that the valuations may serve many purposes, and calls for different figures—original cost, reproduction cost, new, depreciation and other elements of values—that may be utilized for any of these purposes; figures that must be classified as to items, segregated as to states and corporations, and so recorded as to permit keeping continuously up to date in the future. To the railroads and the governments alike it is of the utmost importance that the inventories be complete.

The act covers all carriers doing interstate business. Of railroads there are 250,000 miles, and in addition there are the telegraph and telephone lines. The cost and time required are still somewhat conjectural, but the latest estimates are that the cost to the government alone will have been $20,000,000, and that the work will not be done before 1920. When the act was passed there was no organization whatever to carry it out. Now 1000 men are employed, sixty roadway and numerous other special branch parties are in the field and more than 50,000 miles of railroad have been covered as to grading and track.

Director and Engineering Board Appointed

Announcements were made as they occurred of the appointments of a director of valuation and an engineering board, the division of the country into five districts, the assignment of the members of the board to the districts, the creation of district engineers and the holding of civil-service examinations to secure men for various positions. Only fragmentary information has gone forth as to the shaping of the organization from this point and the carrying out of the work. The aim of this article is to tell what in a general way has been done and is being done.

Even while the first civil-service examinations were pending and no men were available, the heads of the Division of Valuation found much to do. One of the first tasks was to learn which roads do interstate business. This may seem simple. The fact is that many short lines wholly within one state do interstate business, while of the scores of corporations, large and small, that constitute the average trunk line some may, because they do no such business, be outside the jurisdiction of the Division of Valuation. Geographical location, therefore, cannot be made the sole test. The division has not yet the complete list of the properties it must value.

Map Order Issued

Before the government can economically take up the field measurement of the physical plant of any individual railroad it must know what that railroad claims to own or use for railroad purposes. The question of maps, profiles and other records to be furnished by the carriers was fully discussed by the carriers and the Division of Valuation some two years ago, and Valuation Order 1—specifications for maps and profiles—was issued by the government. Its main requirements have been discussed in the Engineering Record.

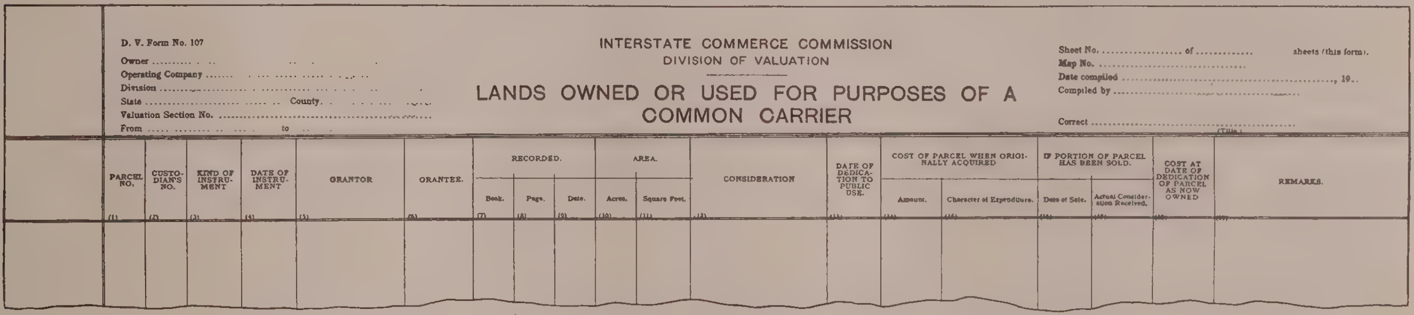
While this order prescribes definite standards for future maps, the government has recognized that many existing maps, though not of exactly the prescribed form, may be perfectly serviceable. Consequently government representatives have visited the main offices of most of the railroads, inspected their maps and indicated which would be acceptable. All maps and profiles must be filed within thirty days after the date as of which the carrier is to be valued.

Supplemental to the map order are various orders calling for schedules of different classes of property. Order 7 covers land, and stipulates forms for a complete record of each parcel covered by a separate instrument of conveyance, one form listing land used for common-carrier purposes and the other covering that not so used. Order 8 covers equipment. Two forms are given for each of a number of classes of equipment—locomotives, passenger-train cars, freight-train cars, floating equipment, shop machinery and the like; one form gives a full outline of the characteristic features of the unit, while the other gives its cost to date, including freight, testing and additions and betterments. These, like most of the schedule orders, must be filed within thirty days of the date of valuation. Order 13, which calls for "a complete inventory of the quantities, units and classes or kinds of property in its roadway and track; bridges, buildings and all other structures; signals and interlockers; telegraph and telephone lines; electrical apparatus; and all fixed property except lands and equipment included in Valuation Orders Nos. 7 and 8," empowers the director of valuation to require the filing of this inventory "upon such dates, in such detail, upon such forms and for such part or parts" as he desires, classified according to the Interstate Commerce Commission's accounts.

The proper treatment of industrial tracks constitutes no small problem in the work, owing to the variety of forms of ownership of such tracks and the variety of agreements between carrier and industry. Order 12 requires the carriers to file a prescribed form listing the industrial tracks along its lines and giving full information as to their ownership. This is one of many phases of the valuation problem that has probably not been gone into thoroughly in other valuations. It is well known, however, that the ownership of the tracks varies all the way from that in which the railroad owns both the land and the track material to that in which the industry owns both, does its own switching and excludes the carriers' locomotives. In some instances the industry has granted to the carrier the strip of land on which the track rests; in others the industry retains the ownership of the land, but the carrier lays claim to the track itself. The Division of Valuation, however, governs itself by the ownership of the land. If the railroad owns the land it is assumed to own the track; if it does not, it must produce proof that it owns the track. This emphasizes the great importance of accurate determination of the right-of-way.

Program for Valuation

The maps and profiles, with the foregoing and other schedules, form the foundation and guide for the government in its field inventory—the checking of the data supplied by the carriers and the measurement and classification of the items of property. When the Valuation Act was passed some of the railroads were well equipped as to



D. V. Form No. 107
Owner ....
Operating Company ....
Division ....
State .... County ....
Valuation Section No. ....
From .... to ....

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

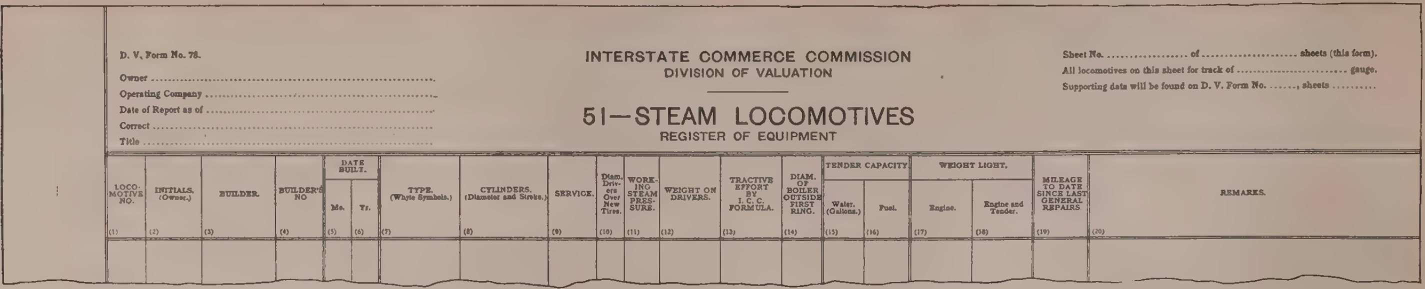
LANDS OWNED OR USED FOR PURPOSES OF A COMMON CARRIER

Sheet No. .... of .... sheets (this form).
Map No. ....
Date compiled ...., 19..
Compiled by ....

Correct ....
(Title.)

	PARCEL NO.	CUSTODIAN'S NO.	KIND OF INSTRUMENT	DATE OF INSTRUMENT	GRANTOR	GRANTEE.	RECORDED.			AREA.		CONSIDERATION	DATE OF DEDICATION TO PUBLIC USE.	COST OF PARCEL WHEN ORIGINALLY ACQUIRED		IF PORTION OF PARCEL HAS BEEN SOLD.		COST AT DATE OF DEDICATION OF PARCEL AS NOW OWNED	REMARKS.
							Book.	Page.	Date.	Acres.	Square Feet.			Amount.	Character of Expenditure.	Date of Sale.	Actual Consideration Received.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)

THIS FORM AND ONE SOMEWHAT DIFFERENT FOR LAND NOT OWNED OR USED FOR CARRIER PURPOSES ARE PRESCRIBED BY ORDER 7



D. V. Form No. 78.

Owner ....

Operating Company ....

Date of Report as of ....

Correct ....

Title ....

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

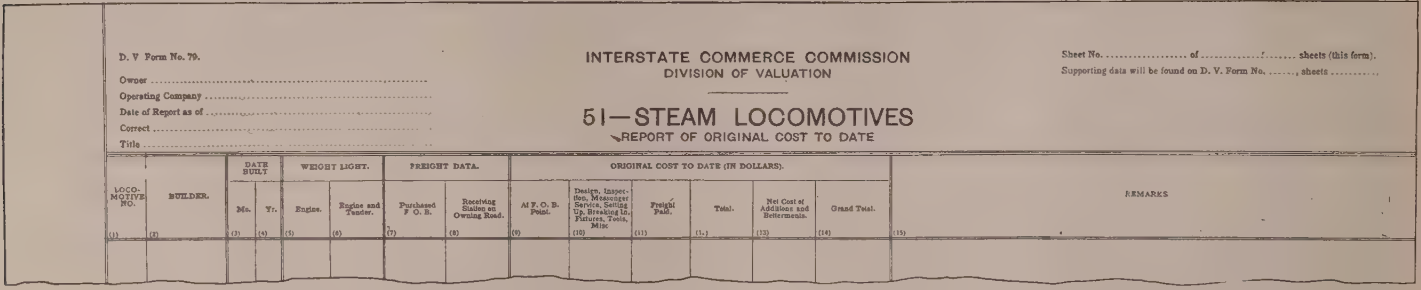
51—STEAM LOCOMOTIVES
REGISTER OF EQUIPMENT

Sheet No. .... of .... sheets (this form).

All locomotives on this sheet for track of .... gauge.

Supporting data will be found on D. V. Form No. ......, sheets ....

LOCOMOTIVE NO.	INITIALS. (Owner.)	BUILDER.	BUILDER'S NO	DATE BUILT.		TYPE. (Whyte Symbols.)	CYLINDERS. (Diameter and Stroke.)	SERVICE.	Diam. Drivers Over New Tires.	WORKING STEAM PRESSURE.	WEIGHT ON DRIVERS.	TRACTIVE EFFORT BY I. C. C. FORMULA.	DIAM. OF BOILER OUTSIDE FIRST RING.	TENDER CAPACITY.		WEIGHT LIGHT.		MILEAGE TO DATE SINCE LAST GENERAL REPAIRS	REMARKS.
				Mo.	Yr.									Water. (Gallons.)	Fuel.	Engine.	Engine and Tender.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)



D. V Form No. 79.

Owner ....

Operating Company ....

Date of Report as of ....

Correct ....

Title ....

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

51—STEAM LOCOMOTIVES
REPORT OF ORIGINAL COST TO DATE

Sheet No. .... of .... sheets (this form).

Supporting data will be found on D. V. Form No. ......, sheets ....

LOCOMOTIVE NO.	BUILDER.	DATE BUILT		WEIGHT LIGHT.		FREIGHT DATA.		ORIGINAL COST TO DATE (IN DOLLARS).						REMARKS
		Mo.	Yr.	Engine.	Engine and Tender.	Purchased F. O. B.	Receiving Station on Owning Road.	At F. O. B. Point.	Design, Inspection, Messenger Service, Setting Up, Breaking In, Fixtures, Tools, Misc	Freight Paid.	Total.	Net Cost of Additions and Betterments.	Grand Total.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(1.)	(13)	(14)	(15)

TWELVE PAIRS OF THESE, WITH MEMORANDUM OF ADDITIONS AND BETTERMENTS AND DETAIL SUPPORTING STATEMENT, COVER EQUIPMENT

records, while many were quite the reverse. The government, therefore, has worked out and is working out a program whereby each district starts the valuation of a few additional carriers each year.

Valuation Orders Nos. 1 and 5 stipulate that each road must be valued as of June 30 of some year, and that each road must be notified at least six months before that date. Order 5, issued in November, 1914, requires each steam railway carrier to file, within thirty days after the date of valuation, complete maps and profiles of its property as of the date of valuation. This order did not apply to the roads already under valuation. The Boston & Maine, for instance, which was one of the first roads in the Eastern District to be taken up, received notice Jan. 16, 1914, that the government field work on its property would be taken up about May 1. This was two days after the issuance of the map order, Order No. 1, and prior to the formation by the railroad of a valuation department. It was found that more than half of the road would require resurveys and new maps, and in this work the railroad has barely kept ahead of the government, the roadway parties of both virtually completing their task at the beginning of last winter. The Boston & Maine work is described in the Engineering Record of Oct. 30, 1915, page 538

WORKING ORGANIZATION DEVELOPED.

All of the foregoing has to do with the preparing of the way—the notifying of the railroads what data they must furnish, and in what form. While these various orders were being prepared the Division of Valuation was developing a working organization from the eligibles of the civil-service lists. Field squads and office forces were organized. The field work was divided into several branches—roadway and track; bridges; buildings; mechanical; signals; electrical, telegraph and telephone; land. Full instructions were prepared and printed for each branch.

The great advantage of co-operation between carrier and government received early mutual recognition, and this recognition crystallized into the duplicate-note agreement. This agreement provides that if the railroad will send out a "pilot engineer" with each government field party to point out the elements of property and give all the pertinent information possible as to ownership, use, age and structure, the government will in turn furnish him with a duplicate set of the field notes. While the execution of this agreement is optional with the railroads, all under valuation have signed it except a few very small roads which have little or no engineering organizations and whose managements feel that they have little to gain or lose by the valuation. The duplicate agreement is the very basis of the adopted method of prosecuting the work, of the combination camp-and-office cars, and of the elaborate note forms to be described in a later article.

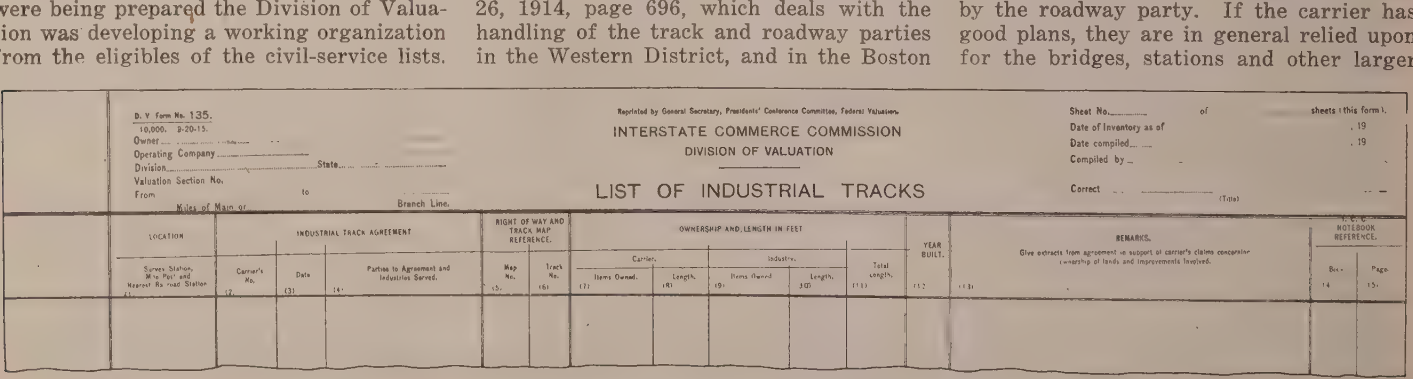
HOW THE FIELD WORK IS DONE

In general the inventory is being done by government forces. Some idea of the way the field work is being done has been presented in this journal in the article entitled "Accommodations de Luxe for Federal Valuation Engineers," in the issue of Dec. 26, 1914, page 696, which deals with the handling of the track and roadway parties in the Western District, and in the Boston & Maine article previously mentioned. The largest parties are the track and roadway parties, which generally consist of nine men. The original plan of having them make hotels their headquarters has been set aside by the development of the combination camp-and-office car or cars, the all-around advantage of which for a large party is obvious. The special branch parties, consisting of one or two men each, working with the railroad's pilot, are obliged to rely on outside accommodations.

The workings of the roadway party are a story in themselves, and will be so treated. Suffice it to say here that it is its duty to measure and record every bit of fixed physical property not in the field of a special branch party, and that it must note over to the special parties all structures, such as bridges and buildings, that it has not covered. Furthermore, the notes must be summarized, condensed and tabulated in such manner that when transmitted to the district office they can be fully understood by men who have not seen the conditions on the ground.

OTHER PARTIES COVER SPECIAL STRUCTURES

While the roadway parties are inventorying what may be called the ordinary structures, the other parties, consisting of one or two men each, are making records of the special structures or elements of property. The bridge, building, signal and telegraph and telephone parties follow the roadway parties (although not necessarily in the same month) in order to have the benefit of the chaining and other notes made by the roadway party. If the carrier has good plans, they are in general relied upon for the bridges, stations and other larger



D. V. Form No. 135.
10,000. 9-20-15.

Owner ....

Operating Company ....

Division .... State ....

Valuation Section No.

From .... to ....

Miles of Main or .... Branch Line.

Reprinted by General Secretary, Presidents' Conference Committee, Federal Valuation.

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

LIST OF INDUSTRIAL TRACKS

Sheet No. .... of .... sheets (this form).

Date of Inventory as of ...., 19

Date compiled ...., 19

Compiled by ....

Correct .... (Title)

LOCATION	INDUSTRIAL TRACK AGREEMENT			RIGHT OF WAY AND TRACK MAP REFERENCE.		OWNERSHIP AND LENGTH IN FEET					YEAR BUILT.	REMARKS. Give extracts from agreement in support of carrier's claims concerning ownership of lands and improvements involved.	I. C. C. NOTEBOOK REFERENCE.	
						Carrier.		Industry.						
Survey Station, Mile Post and Nearest Railroad Station	Carrier's No.	Date	Parties to Agreement and Industries Served.	Map No.	Track No.	Items Owned.	Length.	Items Owned.	Length.	Total Length.			Book	Page
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)

ORDER 12 PRESCRIBES A FORM FOR LISTING INDUSTRIAL TRACKS AND GIVING FULL INFORMATION AS TO THEIR OWNERSHIP

structures; if not, detail measurements must be made. The mechanical parties make careful examination of not less than 10 per cent of each type or series of equipment. The land parties examine the deeds and other papers offered by the railroad to establish their title to the land claimed, and also make a careful study of adjoining lands and prices as indicated by assessments, records of sale and opinions of experts and old inhabitants.

The field parties are manipulated from the district office to suit the conditions of weather, preparation of the railroads and the like. For example, the roadway parties that worked on the Boston & Maine last summer were transferred at the coming of winter to Virginia and New Jersey. One of them was assigned to a certain part of the Central of New Jersey that was ready for them. This party disposed of certain minor lines of this road, as well as a short independent railroad, and was sent to the New York, New Haven & Hartford this spring, partly because it was desired to finish the New Haven during warm weather and partly because some divisions of the Central of New Jersey are not yet ready as to maps and other data.

The office forces assemble all other data received from the roadway parties and the special parties and summarize them according to states, corporations or any other districting system desired.

CONDITION PER CENT AND UNIT PRICES

The railroads have consistently opposed the recording of condition per cent, holding that only deferred maintenance should be taken into account. The field forces of the Division of Valuation are instructed, however, to make estimates of service condition per cent, filling out blanks which give, in addition to the item and its location, the age of former service, age of present service, remaining service life, quality when installed, maintenance, source of data and special notes. There is also a column to check off if the carrier's representative agrees.

No attempt has been made as yet to fix unit prices. This will require a separate journey over each part of the line by a price expert. Meanwhile a cost-data bureau has been organized, and while nothing has been given out officially as to its findings or lines of endeavor, it may fairly be taken for granted that the bureau has been assembling useful information.

TYPICAL LEGAL PROBLEM

Each district has an attorney to pass upon the legal problems that arise. These problems are many and varied. Here is one: Two railroads built long ago terminated on the opposite banks of a wide and navigable river. A ferry service joined the two lines. The two railroads consolidated and sought a permit to bridge the river. This was granted on condition that all passenger trains stop on both banks of the river and carry local passengers across. In time the line became a very important one, carrying a heavy high-speed traffic; and the stopping of all trains at the river became oppressive. Relief was asked from the public authorities, and the negotiations ended in a permit to build a second bridge alongside the first and the discontinuance of the stop proviso, the old bridge, however, to be turned over to the county as a highway bridge. And the two bridges stand side by side to-day, one carrying trains, the other highway traffic. The legal question is, Should the highway bridge be included in any or all of the cost estimates as part of the railroad property "used and useful"?

As to the rate at which the Division of Valuation is doing its work, little can be said, because nothing of the sort has ever been done before, and there is no standard to measure by. Neither can the progress being made now be taken too definitely to estimate when the entire work will be done. The roadway parties are averaging from 4 to 5 miles of all tracks daily for twenty-five working days per month, hence the sixty parties of the Division of Valuation are covering about 6500 miles of all tracks per month. The telegraph parties go much faster, while the speed of the bridge, building and mechanical men naturally varies widely.

There are many fundamental problems to be solved before a final report can be made on any single railroad, as the various valuation conferences testify. It can be confidently stated, however, that the Division of Valuation is shaping its course in such a way as to avoid the necessity of doing the work over if rulings are made on the various moot points.

In view of the conditions surrounding the valuation—the belief of the railroads at the outset that the entire project was needless and a waste of money, the distrust by private interests of the reliability of the civil-service method for obtaining competent men, the fact that many fundamental questions of vital importance are still being debated by the parties concerned—the work of the Division of Valuation appears to be going on with remarkably little friction.

Observatory on Standpipe

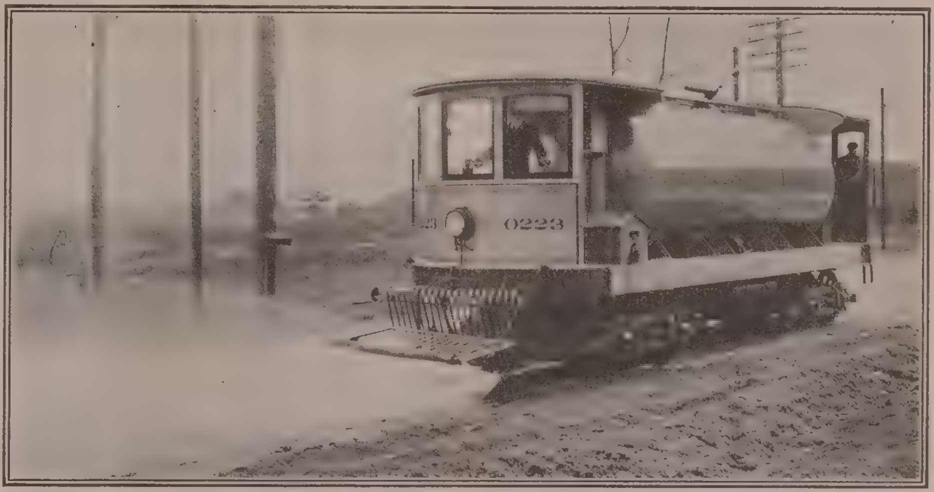
In his annual report for 1915, George A. Stacy, superintendent of the Marlborough (Mass.) water department, urges the joint use of city-owned lands for reservoir and park purposes. He suggests, also, that the city's standpipe could readily be converted into an observatory. A platform erected on the inside of the supporting columns, below the bottom of the tank, Mr. Stacy points out, could be provided with seats and protected with a wire fence on the outside. The observatory level could be connected with the ground by a winding covered stairway. The view from this point of vantage, he says, cannot be equaled between the Blue Hills and Wachusetts.

Cleveland Street Railway Flushes City Streets

Car with 4488-Gallon Tank Cleans 4850 Feet of One Side of Street in 12 Minutes with One Filling of Tank

By H. C. EBELING
Engineer Cleveland Railway

A DISCOVERY by the city officials that a provision of the Tayler ordinance, under which the Cleveland (Ohio) Railway operates, provided that the railway should also "operate hospital and supply cars for the city and such other cars for exclusive municipal purposes as the city shall furnish and maintain," led them to require the railway company to operate tank cars to be employed in flushing and cleaning the streets. Prior to the arrangement whereby the railway company flushed the streets it was required under its franchise to sprinkle them, consequently it had a number of service cars for this purpose. When the municipal authorities decided to avail themselves of the provisions of the ordinance, the railway company was instructed to convert its sprinkling cars into flushers. With the advent of the street-car flusher it was no longer necessary for the railway company to sprinkle the streets, because the dust and refuse were flushed away sufficiently often to make sprinkling unnecessary to keep down the dust. Furthermore, under the old arrangement the expense of sprinkling its right-of-way was borne by the railway, but under the new plan the city reimburses the company to the extent that it furnishes and maintains the flusher cars, pays the cost of operating them, including the wages of the employees and the cost of the power, but contributes nothing toward fixed charges or for track maintenance and renewals.



CAR WILL FLUSH NEARLY A MILE OF STREET, ONE SIDE, IN TWELVE MINUTES

CONVERTING SPRINKLERS INTO FLUSHERS

It was a comparatively simple task to equip the old sprinkler tank cars so that they would serve as flushers. A De Laval centrifugal pump, direct connected to a 15-hp. Westinghouse motor mounted on the same base as the pump, was placed on the front platform of the car. The suction line of the pump was connected to the tank as close to the bottom as possible. The discharge line was furnished with a Y fitting, and a line from each branch of the Y connected to a nozzle over each track rail and about 11 in. above it. A quick-opening lever gate valve was placed in each branch of the discharge line and arranged to be opened and closed from the car platform by means of foot-pedal operating levers. Each valve is operated independently so that either or both sides of the street may be flushed. The motor operates at 550 volts or the trolley voltage, and it is equipped with a suitable starting rheostat.

The nozzles are designed to discharge a fan-like sheet of water over the surface of the street, the nozzle on one side of the car being so adjusted as to clean the devilstrip and the track upon which the car operates, and the other nozzle catches the refuse washed from the track and devilstrip by the first nozzle and carries it to the curb, whence it flows to the sewer. The flushing nozzles are made of cast brass with inner and outer casings. The inner casing has a narrow slot through which the water passes, and the outer casing has a slot a trifle wider. The width of the stream of water is controlled by turning the inner casing. Under ordinary conditions a slot ¾ in. wide by 6 in. long is used.

ADDITIONAL CARS ORDERED

The converted sprinkler cars proved so satisfactory that the company was requested to build two additional double-truck flusher cars. This is the type of flusher shown in the accompanying illustration.

While much depends on the condition of the street and the skill of the operator of these flusher equipments, some idea of their effectiveness may be obtained from the following data taken from the original flusher cars:

Capacity of the tank, gallons	3247
Width of part of street flushed, feet	25
Distance flushed, feet	3500
Time required, minutes	8

On this basis the double-truck or large flushers, having a capacity of about 4488 gal., will flush 4850 ft. of street on one side only in about 12 minutes with one filling of the tank.

Compares Three Types of Lock-Gate Design

Malcolm Elliott, U. S. Assistant Engineer, Defines the Proper Sphere for Vertically and Horizontally Framed Gates

THE LOCK GATES at Panama, Keokuk and Louisville, all for locks 110 ft. wide and about 48 ft. high, but each of a different design, were contrasted by Malcolm Elliott, U. S. assistant engineer, Louisville, in a paper presented recently before the Western Society of Engineers. The Louisville gate is vertically framed, the Panama gate belongs to the horizontal beam type and the Keokuk gate to the horizontal arch type.

Summarizing the comparison between horizontal arch and beam gates Mr. Elliott ventured the opinion that in general arches are more economical and when adequately stiffened against torsion are every bit as satisfactory as girder gates, and that the adoption of the latter type of gates is justified only in special cases where the increased depth of recess would increase the cost of the lock by an amount greater than the saving due to the adoption of a more economical type of framing. This opinion, stated Mr. Elliott, seems to be substantiated by modern practice. The largest gates in this country are those at Keokuk, Sault Ste. Marie and the Cascades Canal, and these are all of the arched type. The Panama gates are of the beam type and no doubt the adoption of this type is justified in this case on account of the locks being in pairs, making it desirable not to increase the width of the foundation as would be necessary with arched gates.

WHEN VERTICAL FRAMING IS DESIRABLE

Turning now to vertical framing it is apparent at once, continued Mr. Elliott, that it depends on the ratio of height to length whether or not vertical framing will be more economical than horizontal framing. For instance, no one would claim that vertical framing would be more economical for the lofty gates of the Panama Canal, some of which are 82 ft. high and only 64 ft. long. On the other hand vertical framing is clearly indicated for the low-lift locks of the Ohio River where the miter gates adopted will be from 17 to 22 ft. high and 62 ft. long. The question is then, at what ratio of height to length do the two general types give equal weights? A mathematical analysis of this problem is not altogether satisfactory, because there are too many auxiliary parts to each type of gate which will not be shown by general equations.

By analysis the weights of horizontal girders and vertical girders are found to be equal when the height is 70 per cent of the length. The figures given, however, do not include a large amount of auxiliary framing, such as the vertical diaphragms in horizontally framed gates and auxiliary horizontal members in vertically framed gates. From actual designs Mr. Elliott has formed the opinion that the extra framing, not expressed in general equations, is greater with horizontal than with vertical framing, and that the ratio found as a result of analyses should be increased to about 1:1. That is, vertical framing and horizontal girders will weigh the same when the height of the gate is equal to its length. When arches are used for the horizontal framing the weights will be equal when the height is about three-fourths of the length. This latter opinion is based largely on the similarity in weight of the Keokuk and Louisville gates.

VERTICAL FRAMING EASY TO CONSTRUCT

A cost-involving element considered by Mr. Elliott almost as important as the weight is the facility of construction. For three reasons the advantage in this regard should be with vertical framing, whether compared with horizontal beams or horizontal arches. First, a vertically framed gate is built on rectangular lines with an almost entire absence of curved work. Second, the erection of that type of gate is much simpler because there are fewer members. Large horizontally framed gates are built up a panel at a time, necessitating careful alignment at each step, while with vertically framed gates, once the few principal members are erected all other parts may be fitted into place without extraordinary attention to alignment and elevation. Last, with the provision for adjustment by means of the adjustable diagonal members, there is no need for extraordinary precision in erection. That it is impossible to use adjustable diagonal members in a horizontally framed gate may, at first sight, Mr. Elliott admitted, seem to be a broad and perhaps extravagant statement; but the fact remains that despite the obvious advantage in using such a system it has never been done with large steel horizontally framed gates, and Mr. Elliott states that he is not aware of any method by which it could be used advantageously. Without such a system a gate must be built with such precision and stiffness that when the falsework is removed it will hang in an approximately true position; but with an adjustable diagonal system this extraordinary care is not required, because if the gate is not absolutely true it can be straightened out with the diagonals.

NO SPECIAL OPERATING ADVANTAGE FOR ANY TYPE

The real test of the desirability of any type of lock gate, according to Mr. Elliott, is its ability to perform successfully the functions for which it is designed. Compared with this consideration the element of first cost is trivial, because the cost of the lock gate is generally but a small part of the total cost of a lock, and it would be folly indeed to economize on the first cost of the gates when such economy would result in a continuing loss in efficiency and service. So far as Mr. Elliott has been able to ascertain, there is no marked difference in ease or efficiency of operation between the several types. The cost of maintenance should be less with vertical than with horizontal framing, because of the absence of the large number of small cells into which the latter type is divided by the many intersecting horizontal and vertical members. These cells collect a large amount of deposit in a muddy stream and are difficult of access for cleaning and painting.

In safety or ability to withstand being struck by boats or other shocks, it is not believed that horizontal framing has sufficient advantage (if, indeed, it has any advantage) over vertical framing to influence the choice of type. Generally speaking, when a heavy boat going at high speed hits a lock gate the latter will be wrecked, regardless of its type.

EXAMPLES OF EACH TYPE

There are examples of each type in successful use, although horizontal framing so far has seemed to be standard for large gates. The largest vertically framed gates in use are in the Transatlantic Dock and Bellot Basin at Havre, France. These are for a lock width of 100 ft. and are about 35 ft. high. In this country the largest gate of this type is in the 80-ft. lock at St. Paul. The ratio of height to length is about 1:1. These are the only examples of vertical framing for large locks, so far as is known to Mr. Elliott, but others are to be built in the near future. All of the Ohio River locks, which are not yet built, other than the Louisville lock, are to have vertically framed gates. In these gates the dimensions clearly point to vertical framing, because the locks are 110 ft. wide and the height of the gates varies from 17 ft. to 22 ft. Vertical framing as applied to small gates has been used very successfully on the 45-ft. locks of the Kentucky and Big Sandy rivers.

At Louisville, while vertical framing for the large lower gate was not approved, this type is to be used for the upper gate and guard gate. Both of these span an opening 110 ft. wide. The upper gate is to be about 62 ft. long and 25 ft. high, while the guard gate is of the same length and about 44 ft. high.

Mr. Elliott drew the following conclusions in regard to the relative merits of the three types—vertical framing, horizontal beams and horizontal arches, as applied to lock gates. He believes the advantages of vertical framing within certain dimensional limits have not been sufficiently recognized.

1. There is no very marked difference between the three types so far as efficiency of operation is concerned. The advantage, if any, is with vertical framing, because of a probable smaller maintenance cost.

2. There is little if any advantage of one type over any other type in ability to withstand shocks.

3. Based on conclusions 1 and 2 it may be said that the choice of type should be controlled generally by the relative costs. Generally speaking the most economical type should be selected.

4. Horizontal arches are in general cheaper than horizontal beams. An exception to this rule may occur in the case where the adoption of the arch would result in a large increase in the width of the foundations, on account of the greater depth of the gate recess. This condition does not frequently occur.

5. Vertical framing will weigh less than horizontal beams when the height is less than the length; and will weigh less than horizontal arches when the height is less than three-fourths the length.

6. Vertical framing is superior to horizontal framing as regards facility of construction and simplicity of design.

GATE PARTLY CLOSED—WATER RISING

CAST-IRON GATE DISCHARGING

Automatic Drainage Gates Lessen Need of Pumping

Developed Primarily for Tidal Conditions, Prove Equally Useful Where There Is No Tidal Rise and Fall

LYING, as his lands do, below the high-water mark of a neighboring river, the rancher in the so-called "Island Country" in the Sacramento and San Joaquin valleys, California, is constantly confronted with the necessity of guarding his property against becoming sodden from excess drainage. Pumping in many cases cannot be avoided, but, though the river at high level is always above the lowest part of the land, there are many times when its surface is lower than water on the cultivated territory. Considerable expense has been saved by making use of an automatic gate that allows outward flow, but closes against high water in the river.

Two principal types are used. One of these consists of a concrete culvert under the levee, or bank, and a wooden gate swung from an overhead bar. The commendable feature of this type is that the concrete portion is permanent. Its objectionable features are that it is expensive, difficult to install on account of tides, and requires a special foundation and that the wood cover is not so sensitive as might be desirable.

WOOD GATE NOT SUFFICIENTLY SENSITIVE TO WATER-LEVEL CHANGES

WATER FROM LOW LANDS DRAINING THROUGH INTAKE

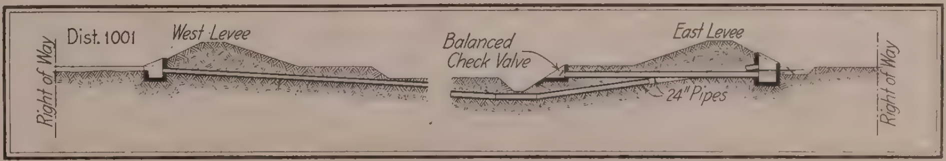
CAST-IRON GATE ATTACHED TO CORRUGATED PIPE AT OUTLET END

Another type considerably used consists of a cast-iron gate swung from an overhead support and closing an Armco corrugated-iron pipe. This gate is said to be extremely sensitive to changes in water level, and is practically watertight when closed. If it is desirable to make the culvert pipe watertight it can be done by extra-close riveting and soldering, or by an asphalt dip. The cost of this class of installation is said to be less than half the cost of the first.

USES

In Reclamation District 1001, Sacramento County, the cast-iron-gate type was used for the purpose of siphoning small drains from one side of a cut-off canal to the other, on conduits to allow excessive run-offs from the district itself to reach the drainage canal, and for the handling of water to be regulated on either side of the canal for irrigation purposes.

In handling the water from one side to the other the corrugated pipe was built into concrete basins at either end. In controlling excessive run-off water the front gate was designed to operate under very small variations of head.



SYSTEM OF DRAINS AND AUTOMATIC-GATE CONTROL USED ON RECLAMATION DISTRICT

Present New Methods of Testing and Experimental Results of Value to Civil Engineers and Contractors

Abstracts of Some of the Papers Delivered at the Nineteenth Annual Meeting of the American Society for Testing Materials at Atlantic City, June 27-30

Apparatus for Determining Soil Pressures Devised

Equilibrating Disk for Use with Air-Pressure and Electrical-Contact Indicator Gives Satisfactory Results

By A. E. GOLDBECK and E. B. SMITH
Office of Public Roads and Rural Engineering, Washington

THIS PAPER describes an apparatus for measuring the pressure under earthfills or against walls. A small cell having a thin brass, annular diaphragm is buried at the desired position, with pipe and electrical connections to an air supply and electrical equipment. Air pressure within the cell equilibrates the external soil pressure as indicated by breaking electrical contact, and the pressure is read on a pressure gage. Typical calibration results are given.

Difficulty of Problem

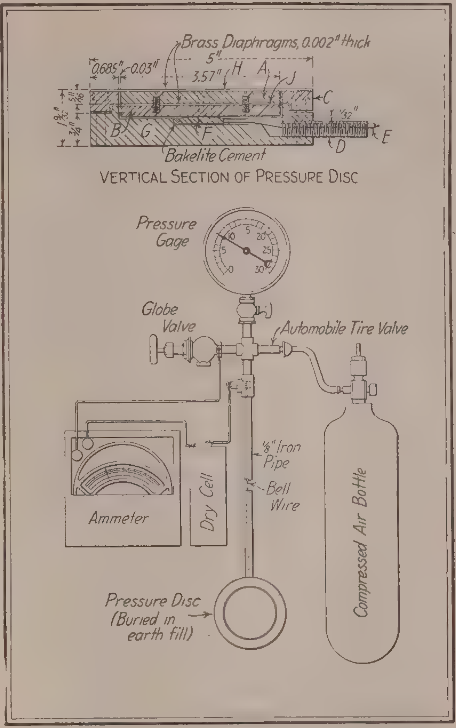
Measurement of the pressure of earth against or under a wall or other structure is rendered difficult because the location at which measurements should be made is almost impossible of access without disturbing the soil, and such measurements have not been accomplished, because no apparatus seems to have been designed for this use whose action does not have some influence on the very pressure it was constructed to measure.

In view of the fact that friction and cohesion between soil particles exist, it is evident that an apparatus employed for the measurement of soil pressure should be so constructed that no movement of its parts will take place. If the measurement requires a movement against the soil, a higher pressure than actually exists will be indicated. On the other hand, should a movement away from the soil be necessary, an indication lower than the true pressure will be obtained. The authors have therefore attempted to develop an apparatus which will measure the pressure of an earthfill with practically no disturbance of its natural conditions. In considering such an apparatus it was deemed advisable to develop the idea of a portable cell of small size, capable of indicating at some remote station the value of any pressure coming upon it.

Description of Apparatus

After much experimenting, a diaphragm cell has been developed as shown in the accompanying diagram. A cast-iron base *G* is fitted with a diaphragm *J*, held in place by the annular ring *C*. On each side of this diaphragm are disks, *A* and *B*, securely and rigidly held together by means of Bakelite cement and machine screws. These plates have an annular clearance from the ring *C* of 0.03 in., thus allowing only a small annular portion of the diaphragm *J* to be the flexible element. The diaphragm *H* served the double purpose of protection and of stiffening the plates *A* and *B* against side motion and eccentric loads. In the base *G* is placed a slightly crowned contact support *F*, held in place and electrically insulated from the base by Bakelite cement. An insulated bell wire *E* is soldered to the support *F* and passes to the outside connections through the 1/8 in. pipe *D*.

In the development of this cell an attempt was made to reduce the movement of the disk and diaphragm to the very smallest possible value. It was found that a movement of 0.001 in. or more against the soil fill required a very large increase in load. By the adoption of cast iron and steel in the construction, with the use of Bakelite as a cement and insulator under the contact support, and also for cementing the disks to the diaphragm, and by reducing the deforming length of the loaded parts, the elastic deformation has been reduced to about 0.0003 in. The movement necessary to break the electrical contact is not over 0.00001 in. With the present construction and type of cell it has been found easy to obtain check readings on wet and dry sand and on damp clay, without appreciably changing the load on the material.



APPARATUS TO DETERMINE SOIL PRESSURE

Some Results of Tests

Tests were made to gain some idea of the maximum amount of air to be expected in the cell due to its expansion against the fill. The accompanying table shows the results.

The experience gained by the authors in the use of this cell leads them to the opinion that the methods of trial and calibration used are far more severe than any conditions that can possibly be met with in its actual use. It is, nevertheless, realized that the apparatus is capable of being improved so that it will give more precise readings, and the authors are still working toward that end. However, when the enormous variations in the condition of fills are considered it is probable that the present error of the instrument is negligible.

Results of Tests for Error of Instrument

Initial load on disk, lb. per sq. in.	Load on disk at breaking of contact, lb. per sq. in.	Load indicated by mercury gage, lb. per sq. in.	Error, lb. per sq. in.	Material
10.0	10.0	10.2	0.2	Damp sand, clay
15.0	15.0	15.6	0.6	Damp sand, clay
20.0	20.0	21.0	1.0	Damp sand, clay
5.3	5.3	4.7	0.5	Dry sand
8.3	8.3	7.8	0.5	Dry sand
11.0	11.0	11.2	0.2	Dry sand
13.8	13.8	14.0	0.2	Dry sand

It is intended to bury a number of these cells in a horizontal or vertical position within earthfills. One set of indicating and controlling instruments mounted in a convenient carrying case is all that is necessary for reading any number of pressure cells. The cost of each cell when made in lots of ten should be about $15 and the cost of one complete indicating and control apparatus without a case would not exceed $40.

There are a number of other uses to which the apparatus may be adapted. Thus, the pressure of concrete in forms may be determined very readily, that of ensilage in silos, the pressure of various finely divided solids in bins, and that of any material that may be slightly compressed without an appreciable increase in the pressure exerted against the instrument.

Clamped Splices Tested for Concrete Reinforcement

Investigation of Three Types Shows That Full Working Stress of Steel Reinforcement Is Developed

By E. L. LASIER
Laboratory Assistant, Bureau of Standards, Washington, D. C.

U-BOLT clamped splices of both 17 and 21-in. lengths were tested by the writer to determine the load at first slip and the maximum load the splice would resist. Three different classes of splices were tested: (1) lap splices not embedded in concrete, (2) butt splices not embedded in concrete, and (3) lap splices embedded in concrete. The steel in all cases consisted of 1-in. square cold-twisted bars.

The loads necessary to produce first slip had a range of from 7000 to 50,000 lb. The maximum loads which the splices withstood varied from 23,000 to 69,000 lb. The ratios of load at first slip to yield point of bar for clamped splices not embedded in concrete varied from 12 to 21 per cent, and for splices embedded in concrete from 53 to 83 per cent. Ratios of maximum loads to tensile strength of bar ranged from 31 to 61 per cent for unembedded splices and from 79 to 95 per cent for embedded splices.

CONCLUSIONS

As a result of these tests it was found that (1) lap splices are stronger than butt splices, (2) splices in which the two overlapping bars are of opposite twist apparently are stronger than splices in which the bars are of like twist, (3) the lengths of lap, as to the two lengths tested, did not apparently affect the strength of the splices, (4) embedding the splices in concrete increases their strength materially, and (5) clamped lap splices embedded in large masses of concrete undoubtedly can safely withstand a unit load equal to the allowable unit stress in the steel reinforcement.

Test Endurance and Impact Strength of Metals

New Machines Devised to Apply Alternating Torsion Stresses and Impact by Shearing Unnicked Specimens

By D. J. McADAM, Jr.
Metallographer, Engineering Experiment Station, Annapolis, Md.

THE following methods of endurance and impact testing have been originated at the U. S. Naval Engineering Experiment Station. Although sufficient time has not been available to compile a very complete series of results obtained with a great variety of metals, the experiments have been carried far enough to show that the methods are of value.

ALTERNATING TORSION TEST

The testing of failed shafting and of forgings intended for use in shafting led to the idea that endurance tests by means of alternating torsion would give results of considerable value. A satisfactory machine, however, for carrying out such tests was not available until one was invented by L. E. Foster, working in the metals laboratory of the station. This machine, a modification of the Upton-Lewis type, has been used in a number of tests at the station and has demonstrated its value in determining the serviceability of metals. Alternating torsional stress is applied to one end of the specimen by an arm which is given a reciprocal motion by an eccentric attachment to a rotating wheel. The stress is measured by the movement of two springs which resist the motion of an arm attached to the other end of the specimen.

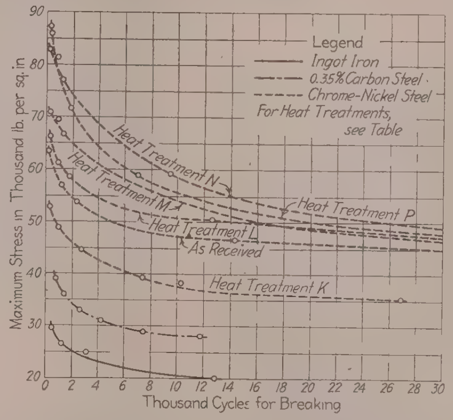
TESTS AND RESULTS

Tests have been made with plain carbon steels, alloy steels of various composition, and with nonferrous alloys. The observation of the material during test often proves as valuable in determining the quality of the metal as the numerical values obtained. Metal which contains slag or other forms of segregation soon shows cracks extending along the lines of segregation, while uniform material usually shows no crack until it breaks transversely. In longitudinal specimens the failure often starts by longitudinal cracks, while transverse specimens of the same material show no cracks until the final transverse break. Since a cylindrical test specimen 1½ in. long and ½ in. in diameter is used, plenty of opportunity is afforded to study the surface of the metal under test.

The results obtained with various kinds of steel are illustrated by the curves in the accompanying diagram. In these curves, nominal maximum stresses are plotted as ordinates and the number of cycles to break as abscissæ. Though the stresses are beyond the elastic limit, they are calculated by use of the same formulæ that apply before the limit of elasticity has been reached. The stresses are therefore merely "nominal." The chrome-nickel steel, which had received various heat treatments as noted, had the following chemical composition in per cent: Carbon, 0.30; manganese, 0.60; nickel, 3.50, and chromium, 0.70. The heat treatment given by the manufacturer was: Quenched in oil from 1600 deg. Fahr. and annealed at 1350 deg. Fahr. It will be noticed that the heat treatments (given at the station) for five specimens in the diagram differ chiefly in the temperature of final annealing. As this temperature is lowered the curves become higher, but their steepness is greatly increased.

RESULTS OF ALTERNATING TORSION TESTS

Treatment letter	Reheated to —deg. F., held ½ hr.	Cooled in	Reheated to —deg. F., held ½ hr.	Cooled in
K	1450	Furnace	....	....
L	1450	Oil	1300	Furnace
M	1450	Oil	1200	Furnace
N	1450	Oil	1100	Furnace
P	1450	Oil	1000	Furnace



RESULTS OF ALTERNATING TORSION TESTS

A method of impact testing has been developed at the station which it is believed is free from many of the disadvantages of methods previously used. So far as can be learned by the writer this method has not been previously used. The method consists in the shearing of an unnicked specimen by impact, and the measuring of the energy thus utilized. Although this impact shear could be applied by various methods, it was applied in these experiments by means of a swinging pendulum, as in other well-known methods now in use. The residual energy in the pendulum is measured by the height to which the pendulum swings after the specimen is broken.

Although various kinds of steel were used in these tests, the specimen (⅜ x ¼ in. in cross-section) was always sheared off so as to give a smooth cut. The piece cut off showed practically no deformation. One advantage of the use of unnicked specimens is that the same specimen, about 1½ in. long, could be raised after each cut and thus sheared several times. With uniform material very consistent results were obtained in this way.

RESULTS OF IMPACT TESTS

There is no easily discovered relation between the results of impact tests and those of tension tests. For example, ingot iron with low tensile strength and high ductility gives nearly as good impact results as the chrome-nickel steel of high tensile strength and rather low ductility. The results with the chrome-nickel steel lead to the same conclusion. As the final drawing-back temperature is lowered, the tensile strength and elastic limit are raised, while the elongation and reduction of area are not much affected until a drawing-back temperature of 900 to 1000 deg. Fahr. is reached. The impact-shear results, on the other hand, drop rapidly as soon as the drawing-back temperature falls below 1200 deg. Fahr. Evidently, therefore, the impact-shear test is of value in detecting brittleness, even when the brittleness is not revealed by the ordinary tension tests.

The 0.35 and 0.5 per cent carbon steel, in the annealed condition, gave slightly lower values than those obtained with 0.1 and 0.2 per cent carbon steels. By oil quenching and tempering, however, the medium-carbon steels gave results about equal to those obtained with ingot iron. Evidently, therefore, these tests indicate that the pearlite-ferrite structure does not give quite as good impact results as the sorbitic structure, in which the carbon is more evenly distributed.

The results obtained with the nickel steel, having 0.35 per cent carbon and 3 per cent nickel, were somewhat surprising. Neither annealing nor oil quenching and tempering gave results equal to those obtained with plain carbon steels, although the tension-test results were greatly improved by the latter heat treatment. Annealing gave slightly better results than the quenching and tempering. Since it is possible that the samples used are not entirely representative, further experiments will be made before final conclusions are drawn.

The effects of various heat treatments on steel of various kinds will be investigated further and a comparison of results by tension, torsion, impact and endurance tests of various kinds will be made.

Strength the Essential in Concrete Aggregates

New Form of Specifications Offered Which Makes It Possible to Utilize Good Material Close at Hand

By CLOYD M. CHAPMAN
Engineer-in-Charge, Westinghouse Church Kerr & Company, New York City

INSTEAD of specifying that concrete aggregates, particularly sand, be of a certain fixed minimum standard of quality, which may not be attained in certain localities, it is proposed that specifications be made to read, in effect, as follows: "The materials used shall be of such quality, and shall be used in such proportions, as to produce a concrete which shall show a compressive strength of 2500 (or 2000 or 1500) lb. per square inch at the age of 28 days, when tested in accordance with the standard methods of testing."

A brief outline is given of the manner in which this form of specification is utilized in practice by Westinghouse Church Kerr & Company and the method of checking up the quality of fine aggregates as they are received on the job, by the use of the sand tester. [See the Engineering Record of June 26, 1915, page 821, and the series of articles beginning in the issue of June 12, 1915, page 734.—EDITOR.]

ACCEPTABLE SPECIFICATIONS

To be generally acceptable, specifications for concrete aggregates should fulfill two requirements: (1) they should insure the production of suitable concrete if the aggregates are properly used, and (2) they should permit the use of materials found in the vicinity of the work, if such materials are capable of producing concrete of the required quality. The present method of specifying may insure the quality of the material, but it does not permit the use of a wide choice of aggregates from which first-class concrete may be made.

Present specifications for sand require that it shall, when tested as prescribed, show a compressive strength approximately equal to that obtained from standard Ottawa sand. A rigid adherence to these specifications would mean that in many sections of the country no concrete work could be done without importing aggregates from a distance. The result is that the specifications are ignored in those localities and the work is done without them.

On the other hand, where most excellent materials are available the present specifications for sand do not permit of variation of the proportions used, no matter how good the materials may be. Wherein lies the incentive to a contractor or builder to use any better materials than the cheapest, if he is compelled by the specifications to use a certain arbitrary mix, regardless of quality or material?

NEW SPECIFICATIONS SUGGESTED

In order to cover and include all materials which are capable of producing concrete of the quality required for the particular service it is to perform it is only necessary to specify the result required instead of specifying the materials used.

Let it be assumed, for instance, that for mass foundations and footings, for retaining walls and abutments and for similar service a concrete which has a compressive strength of 1500 lb. per square inch at the age of 28 days is suitable. For reinforced walls and matts where stresses are moderate a compressive strength of 2000 lb. at 28 days may be required, while for reinforced floor slabs, beams, girders, columns, etc., a minimum compressive strength of 2500 lb. per square inch at the same age may be necessary. By specifying the results required and permitting the use of such materials as will produce these results when tested under the specified and standardized conditions, it is possible not only properly to safeguard the products but to permit the use of such materials as are available in each locality.

In operating under such specifications it is of great importance that specimens of the concrete produced on the job be regularly made and tested. It is also of the greatest importance that a close check be maintained on the quality of the materials used, so as to insure a reasonable uniformity, and to know that these materials are at least equal in quality to the materials used in arriving at the proportions required to give the quality of concrete called for in the specifications.

The regular and systematic testing of the size of the aggregate gives data which will permit the engineer to tell without further tests whether the aggregates will produce a better or a poorer concrete than that produced by the original or standard sample. This fact is based upon the well-established principle that, other things being equal, the aggregate with a granulometric-analysis curve most nearly approaching the line of maximum density will produce the best concrete.

Among the tests made on sand are several granulometric-analysis guide charts made with a sand tester. As the sand arrives on the job the inspector makes the test with the sand tester and compares the resulting chart with the guide chart. If the results show greater variation than is permissible, the matter is taken up with the one who supplies the sand.

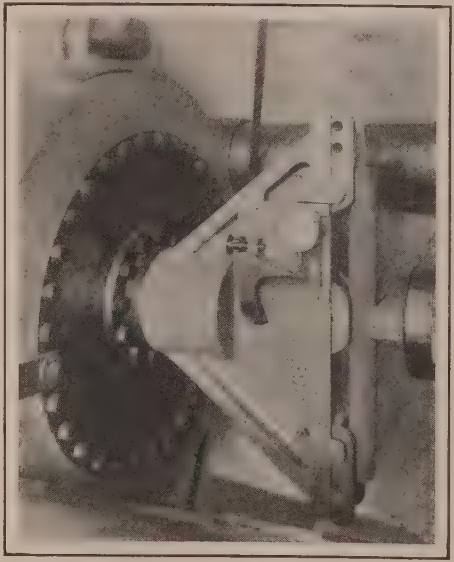
Experience with this form of specification has shown it to be advantageous in localities where the available aggregates are not up to the standards now specified.

Device Measures Deflection of Arbitration Bar

New Apparatus for Use with Emery Testing Machine at Watertown Arsenal Is Designed to Utilize Ames Dial

By H. L. MORSE
Major, Ordnance Department, U. S. A., Watertown Arsenal

THIS PAPER presents the design of an apparatus for testing the standard cast-iron arbitration bar. The deflection-measuring device of the apparatus utilizes the Ames dial by means of a thrust spindle and bell crank in such a way as to give an accurate measurement of deflection at the instant of fracture of the bar and at the same time avoid any probabilities of injury to the dial.



APPARATUS IN PLACE ON MACHINE

The problem presented was to measure, at any load or at rupture, the deflection at the center of a practically cylindrical rough casting of 1¼ in. diameter supported at both ends, with a free span of 12 in., and stressed transversely by a load applied at the center of the span. Variability of length between supporting points was made necessary for the reason that the best length of the arbitration bar might ultimately be determined to be 16 or 18 in.

DESCRIPTION OF MACHINE

The machine to which the apparatus was to be applied is the familiar Emery horizontal type. As the starting point of design was conditioned by the design of this machine, to the two pistons of which the loading and weighing elements of the apparatus must be attached, so the final as well as the intermediate character of the train of elements of the deflection-measuring device was conditioned by the choice of the Ames dial as the deflection indicator. This dial was chosen because several were available, the laboratory personnel was accustomed to its use, and simplicity, durability and sufficient accuracy seemed therein to be admirably combined.

The photograph shows the apparatus designed to meet these conditions as it appears in the testing machine, with the arbitration bar in place ready for tests.

Up to the time of writing, about thirty bars had been tested with entirely satisfactory results, with a possible exception of the behavior of the spring. A recent test of the accuracy of the deflectometer in place, using an inside micrometer against the wedge end of the spindle, showed an apparent error of 0.0008 in. in a total movement of 0.03 in. Of this error probably half was due to the flexure of the micrometer mounting. The design is such that the deflectometer is not subjected to any appreciable stress during the test, so that it is proper to assume that the error just noted is the maximum which will occur in actual use. This degree of accuracy is believed to be entirely sufficient for this character of test.

Wear of Concrete in Roads—How Tested

Tests Used for Determining Resistance of Wearing Surface Briefly Reviewed—Rattler Test Advantageous

By D. A. ABRAMS
Material Research Laboratories, Lewis Institute, Chicago

THE extensive use of concrete as the wearing surface of roads and pavements has given renewed interest to experimental studies of the wearing resistance of concrete. If weather resistance and structural stresses are properly provided for, the life of a road will depend on the wearing resistance of the material of which it is built. Satisfactory wearing resistance is one of the most important considerations of any materials to be used in road surfaces.

Numerous testing machines have been designed for use in determining the abrasive resistance of natural rock, cement mortars and brick. The following are typical of the methods which have been used: Dorry hardness testing machine; sandblast; Deval abrasion testing machine; pavement determinators, and the Talbot-Jones rattler.

EXPERIMENTS WITH RATTLER

The writer is now making studies of the wearing resistance of concrete at the structural-materials research laboratory, Lewis Institute, Chicago, in which the Talbot-Jones rattler is being used. The test pieces consist of blocks 8 in. square and 5 in.

thick, cast in metal forms made from 5-in. steel channels. They are arranged around the perimeter of the drum of the rattler.

About 200 concrete blocks have been tested in this way. The tests thus far have been carried out primarily for the purpose of studying the action of the machine. A few variations in the mix, aggregates, condition of storage of the concrete, etc., have been made, but the tests are not considered to be of sufficient scope to justify presenting the results at this time. The loss in weight due to the tests has varied from 8 to 25 per cent.

This method of making wear tests of concrete by the use of a rattler is believed to have the following advantages: (1) the concrete is subjected to a treatment which approximates that of service: (2) the test piece is of usual form and of sufficient size so that representative concrete can be obtained; (3) the test pieces are convenient to make, store and handle; (4) the cost of the tests is not excessive; (5) the machine used is found in numerous testing laboratories; (6) the wearing action takes place on the top or finished surface of the concrete; (7) several tests may be made at the same time, thus enabling more representative results to be obtained; (8) tests may be made on sections of concrete cut from roads which have been in service, and (9) other paving materials, such as brick, granite blocks, etc., may be tested in the same way.

The tests indicate that this method may prove of considerable value in studying the relative merits of different aggregates, mixes, consistencies, time of mixing, surface treatments, etc., on the wearing resistance of concrete. It can readily be used as a control test on blocks made at frequent intervals as the work progresses.

Convict Labor on Roads Not Always Economical

Convict labor under certain conditions is not economical, according to Dr. L. I. Hewes, engineer of the Office of Public Roads and Rural Engineering. This office is conducting an experimental convict road camp near Atlanta, Ga., with a view to a thorough study of the subject. It has already been found that the prevailing system of feeding the convicts involves a waste of 4½ cents per day per man in the one item of ordering supplies and disposing of waste. In other localities the methods of guarding and the expense items not charged will run the cost of convict labor beyond the value of the service performed.

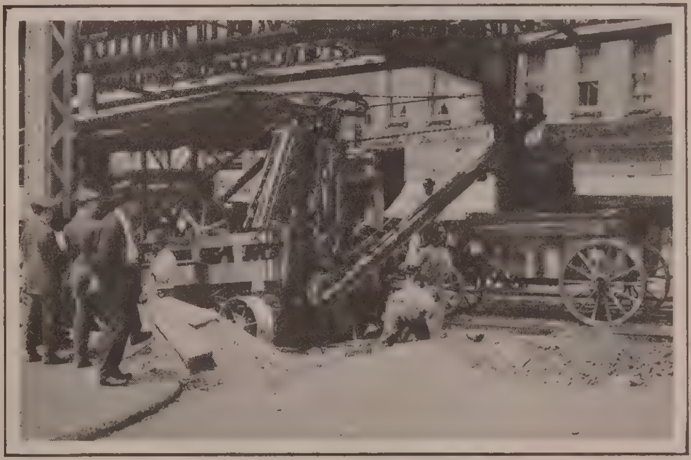
Steam Shovel Removes and Loads Old Pavement and Foundation

Granite-Block Pavement Being Laid on Broadway, Brooklyn, to Replace Worn-Out Wood Block—Joints Made with Tar and Sand

MOVING forward at the rate of 400 to 600 ft. a day, despite interruptions caused by the passing street cars, a steam shovel is removing from Broadway, Borough of Brooklyn, New York City, the old wood-block pavement and 5-in concrete foundation, over a strip 11 ft. wide, and loading it on trucks to be carted away, preparatory to repaving the street with improved granite blocks.

A gang of laborers follows the shovel and removes the earth remaining to the new subgrade, 3 in. below the old. This is compacted by a 10-ton steam roller, and the new concrete, 6 in. in thickness, is placed at the rate of 137 sq. yd. an hour by a machine with a rated capacity of 100 sq. yd. an hour. In this class of paving in Brooklyn the present practice is to fill the joints with a 1 : 1 mixture of fine screened sand and tar. Labor is saved over the usual methods of making this mix with a hand-operated mixer.

MACHINE TEARS UP AND CRUMBLES OLD CONCRETE FOUNDATION



FLAP BOTTOM ENABLES BUCKET TO UNLOAD INTO TRUCK

A Heavy Traffic Street

Broadway between Havemeyer Street and Myrtle Avenue, the limits of the work, is a heavy traffic street. During the working hours there is an almost continuous stream of trucks. There is also a street-car line on which cars pass every few minutes, and overhead is an elevated railway.

The steam shovel is operated by two men and equipped with a ½-yd. bucket. The boom is so placed that it can be lowered parallel to the ground and raised and rotated about a horizontal axis to load the trucks. The bucket slides back and forth along the boom and has a flap bottom controlled by a line from the engine.

In operation the boom is lowered to a position approximately parallel to the ground and the bucket slides back and forth along it, digging its teeth into the material to be excavated until it has its load. The boom is then raised and the load dumped into a truck standing alongside.

CONCRETE BROKEN UP BY BUCKET

The concrete in general is thoroughly broken up by the teeth of the bucket, though at times slabs as big as 2 and 3 ft. in diameter are picked up and dumped. The space in which the shovel works is confined on both sides and above by the elevated railroad structure and the passing surface cars. The truck loading is accompanied by many unavoidable delays, such as trucks being compelled to pull out at frequent intervals to permit the car traffic to pass and getting the shovel over street intersections where it is not desired to tear up the old pavement for the time being. Despite the delays the shovel removes and loads 600 lin. ft. of block pavement to a width of about 11 ft., or from 400 to 600 lin. ft. of 5-in. concrete foundation in an 8-hour day.

The shovel, which was manufactured by the Keystone Driller Company, of Beaver Falls, Pa., requires, besides the engineer and fireman, a foreman and two laborers, the latter to bring up the teams and level up and lay planks under the wheels for it to travel over. It moves forward under its own power.

NEW SUBGRADE LOWER THAN OLD

As the new subgrade is about 3 in. lower than the old, a gang of laborers follows up the shovel to remove the necessary material and level the grade preparatory to its being compacted by a 10-ton steam roller.

Following the roller comes a Koehring paver, which mixes the concrete for the new 6-in. foundation to 1:3:6 proportions and places it by means of an extension boom on which the delivery car runs. Laborers level this off and tamp it. The rated capacity of the mixer is 100 sq. yd. a day. On this work it is doing 137 sq. yd.

On top of the concrete foundation a 1-in. thickness of sand is spread, and on this the improved granite blocks, measuring from 3¾ to 4¼ in. in width, 4¾ to 5¼ in. in depth and from 8 to 12 in. in length, are laid with joints of not less than ⅜ in. and not more than ½ in. wide.

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The joints are filled flush to the surface in two pourings with a mixer of fine screened sand and tar mixed in equal proportions. Both the sand and the tar are heated to not less than 250 deg. Fahr. and not more than 325 deg.

Formerly the joints in this class of pavement in Brooklyn were partly filled with small gravel, and then the tar was poured into them to fill the voids between the gravel. The method was always very unsatisfactory, because no matter how carefully the workmen were watched, the tendency was to fill the joints with the gravel so that the tar would penetrate only a short distance into the joint, giving a very unsatisfactory result.

The usual way of making this mix in the borough is by puddle, men with pails standing near the pavers and mixing the joint materials as they are brought to them.

On the Broadway work the mix is made in a machine devised by Fred Hesse, granite paving contractor, of Brooklyn. The machine consists of a rectangular iron tank through which an axle, carrying 3-in. blades spaced 7 in. center to center, is run. The axle is rotated by one man turning a handle, connected to it by cogwheels set at right angles. The heated sand and tar are poured in through the open top of the tank and the mixed product flows out through a pipe in the front into pails, by which it is carried to the joints and poured.

SAND AND TAR MIXTURE POURED FROM PAILS

Though the labor of five men is saved over the ordinary method of making the mix, the machine is unsatisfactory, in that not being connected directly to the tar heater there is danger of the material becoming chilled while being carried to the mixer. An improvement has already been perfected by Mr. Hesse, a patent for which has been applied for. This will be connected directly to the tar heater and will be operated by a gasoline motor.

The joints are poured twice. In the first pouring they are filled to the top, but contraction on cooling and gradual settlement to the bottom leave a space in the upper section. On the second pouring these voids are filled up flush with the top of the block and slightly overflowing. No working of the material or puddling is done. The two pourings complete the joint work.

The work is being done by the Charles A. Myers Contracting Company of Brooklyn under the direction of the Bureau of Highways of the borough, of which H. H. Schmidt is chief engineer. E. D. Rhame, division construction engineer, is directly in charge of the work.

Cheap Devices Used in Reconstructing Truss Bridges Eliminate Costly Centering

Two Problems Analyzed in Detail Show How Warren Double Intersection Truss and Pettit Truss Highway Bridges Were Strengthened

By E. J. DOYLE
Consulting Engineer, Albany, N. Y.

How to devise economical methods for making repairs or strengthening existing bridges is often a difficult problem. In many cases the outlay necessary to put the bridge into proper condition safely to sustain the increasing live loading, especially on highway spans, is so high that the work is postponed until economical repairs become impossible. By eliminating the relatively high cost of centering, a large saving can be obtained. Simple erection devices, with careful computation of the existing stress and well-planned operations in changing members, making connections and strengthening splices will be described by two typical examples, showing an estimated saving of $4,800 and $2,700 respectively.

Analyzing a Problem

Consider the case of an ordinary riveted truss bridge, with plank roadway and sidewalks, that has been in use for a period of fifteen years and is in need of repairs. A careful examination will disclose that the lighter members, such as diagonals and wind braces, are rusted away to a considerable extent at their contact points with the floor, gusset plates or other places where dirt and moisture lodge. The chord members will be found to be deteriorated to the greatest extent at connection points, such as splices, gusset and batten-plate connections and where pockets exist.

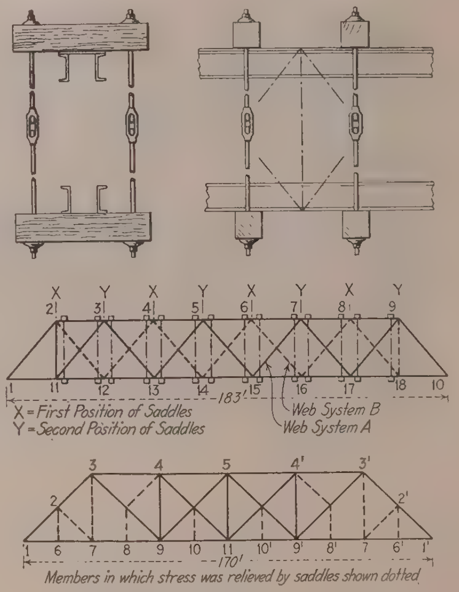
The actual amount of metal lost may be small and yet the effective cross-section will be seriously reduced. The structure as a whole may be in a fair state of preservation, and if the defective members could be reinforced or replaced at a reasonable cost per pound for new metal, repairs would often be promptly made; but it often happens that conditions under the bridge are such that the cost of a system of falsework would be as much as 25 per cent of the cost of a new bridge and therefore nothing is done.

Repairing without Falsework

The writer has repaired several structures such as described above and has found that it pays big dividends in the form of money saved to analyze a repair problem with as much care as would be taken in the design of a new bridge. A case in point was the repair of the Rensselaer Street viaduct at Troy, N. Y. This structure carried traffic from a city street and was located over the terminal yards of the Boston & Maine Railroad. It consisted of a two-span double-intersection through Warren truss with riveted connections. The longest span is shown in outline in Fig. 1.

The reconstruction plans called for the replacing, in whole or in part, of all diagonals and the reinforcing of the lower chords with heavy plates, which were to be riveted to the face of the channels. Before reconstruction work was started a careful examination was made of all truss members, the least effective section of each being determined and tabulated in a table. The strength value of each member was computed and tabulated, a unit tensile value of 15,000 lb. being allowed. Stresses due to dead loads, with roadway pavement and base removed, were computed on the assumption that each web system would take all the loads and that only one system would be loaded at a time.

To allow the replacing of web members, provision was made for removing one entire system of diagonals at one time by relieving it of any load. This was done by setting up saddles, shown in Fig. 1, over the upper-chord panel points of the B system, and throwing loads from the A system into the B system by drawing up on the turnbuckles. The A system members were then cut out and replaced, after which the saddles were released, set up over the upper-chord panel points of the A system and drawn up, throwing the B system loads into the A system. The B system members were then cut out and replaced. The hardwood timber was used in the saddles. The bars were upset, with a nut on each end, and the turnbuckles were placed to come about 3 ft. above the floor line. As but one truss was repaired at a time, saddles were required for only one system.



Members in which stress was relieved by saddles shown dotted

FIG. 1—DOUBLE INTERSECTION WARREN TRUSS, WITH DETAILS OF SADDLE

The reinforcing plates that were placed on the face of chord channels necessitated cutting away the rivets of the diagonal and splice connections. This work was made possible without shoring by the method illustrated in Fig. 2. Pins about 1 ft. longer than the out-to-out spacing of the chord channels were made of shaft steel, slightly tapered for a distance of 2 in. from each end and of a driving-fit size.

In placing the reinforcing plates at the diagonal connections, opposite rivets in pairs were cut out and a pin driven in their place, another pair of rivets cut out and replaced with a pin, this being repeated until all rivets were replaced with pins except that a few rivets were replaced with bolts to secure the connection temporarily. The reinforcing plates were then put in place over the ends of the pins, drawn down close with bolts, and one pin at a time backed out and replaced with rivets until the connection was riveted up.

REINFORCING SPLICED JOINTS

The general method of placing the reinforcing plates at the chord splice points was the same as described for the diagonal connections, except that it was necessary to remove the old splice plates *a*, Fig. 2, to allow the new reinforcing plate to come into contact with the face of the chord channels. Before any pins were driven, new splice plates *b* were put in position as shown, about 3 in. from the back of the channels, to allow the backing out of the rivets. A pair of rivets was then cut out and replaced with a pin driven through the new splice plates, the operation being repeated as described in the former case. The new splice plates *b* were then drawn down to the back of channels with bolts, the old splice plates *a* removed, the reinforcing plates put in place over the ends of the pins, the old splice plates replaced on the outside of the reinforcing plates, the pins backed out one at a time and the connection riveted up.

Before this method of repairing was adopted a study was made of the ordinary method of centering, but due to the fact that the structure was located over the railroad yards at a point where several crossovers existed and where very little accommodation for supports could be had, its cost would be excessive. An estimate indicated that a system of centering would cost about $5,000.

The cost of materials used for saddles and pins was $76, and the cost of manipulating them was about $125, so that the total cost of supporting by the method adopted was about $200, as against an estimated cost of $5,000 for the ordinary method of centering. The work was carried on without a mishap or difficulty of any kind, and it is believed that the repair work was done in less time than would have been required to construct a system of centering.

APPLICATION TO HEAVY PETTIT TRUSS

Another instance where the principle of supporting without the use of falsework was adopted was in connection with a heavy Pettit through riveted truss that was to be repaired and reinforced to carry heavier interurban electric car loads than those for which the bridge was designed. An outline of the truss and typical details are shown in Fig. 3. The bridge had a single span of 170 ft., a 24-ft. roadway and two 6-ft. sidewalks, with two lines of electric-car rails in the roadway.

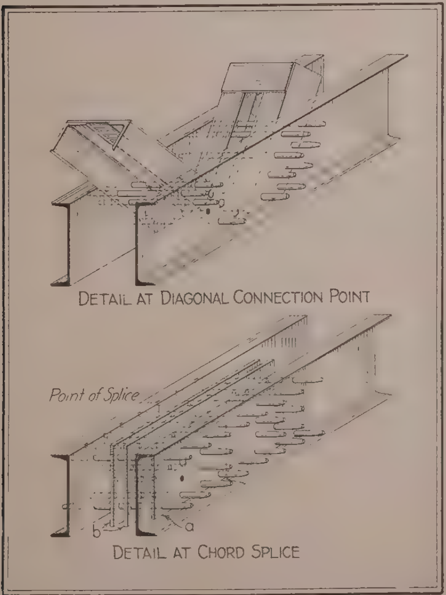


FIG. 2—DIAGONAL JOINT AND CHORD SPLICE DETAILS

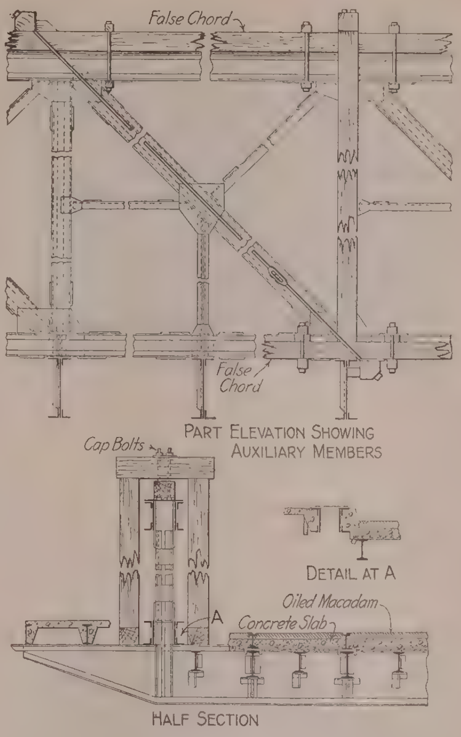


FIG. 3—PETTIT TRUSS, WITH DETAILS OF AUXILIARY MEMBERS

The reconstruction plans called for reinforcing all chord and end-post members and also web members 3-7 and 3-9 with plates, all other web members to be removed and replaced with heavier sections. The floor-beams were to be reinforced and the track stringers replaced with heavier sections, as well as other work that need not be mentioned here because not a material consideration in the centering problem. Because of the increased live load and an increase in the dead weight of steel work, the macadam pavement was replaced with 1½-in. asphalt and the slag concrete base with 5-in. crushed stone with heavier reinforcement.

Before the reconstruction work was started all truss members were examined, the least effective section of each determined and its strength value computed. Stresses due to dead loads with pavement and concrete removed were computed. Stresses due to concentrated loads which would be necessary to bring the shear in any main web member to zero were computed, and the sections, least effective areas, strength values, maximum loads due to any combination of loadings, etc., were tabulated.

WEB MEMBERS RELIEVED OF STRESS

The web members were relieved of stress by two methods, some by one method and some by a combination of the two. The dotted members, Fig. 3, were relieved of stress by the saddle arrangement shown, and the main web members by eccentric ballast loading, which created a zero shear and therefore a zero stress in the member to be removed. In applying the principle of eccentric loadings to relieve stress, however, the stress was not brought to zero by the loadings, but the last 10 per cent was relieved by the saddle and false-post arrangement shown. This was done so that any section of the truss would not be in an unstable condition, which would be the case should the loadings be finely balanced to create a shear of absolute zero.

The secondary web members were relieved of stress in a group. Thus saddles were hung from 3 to 6 to relieve members 2-6 and 2-7, from 3 to 7 to relieve members 3-7, from 3 to 8 to relieve members 4-12 and 12-8, and from 4 to 10 to relieve members 13-10. The members when free of stress were cut out and replaced or reinforced as required. The main web members were of necessity relieved of stress, removed and replaced singly or in pairs of the same panels. Thus, to relieve members 3-9 and 4-9, ballast was concentrated at points 7 and 9 in such quantity that the shear in 3-9 and 4-9 was reduced to 10 per cent of its original amount. The saddle and false post shown in the figure were then put in place and the stress in the members brought to zero by drawing up on the turnbuckles of the saddle rods and by screwing down the nuts on top of the post caps.

The ballast was made up of cement sacks filled with fine gravel, to weigh 100 lb. each. The weight of ballast that would be required was computed in advance and tabulated in a table, care being taken not to load any member in excess of its computed strength value.

REINFORCING THE SPLICES

The reinforcing plates that were to be placed on chords and end posts were put in place by the same general method as has been described for the double intersection Warren truss and as shown in Fig. 2, except that the splices were made with double splice plates. The procedure is illustrated in Fig. 4: 1 shows a chord section with old splice plates *a* and *b*; 2 shows pins driven in the place of rivets and old splice plates *a* removed; 3 shows new reinforcing plate *c* in place or ready to place, new and longer splice plates *d* in place and bolted at the ends or ready to place. The old splice plates *b* are then backed away from the channels, and 4 shows the pins backed out and replaced with bolts, the old splice plates *b* left free; 5 shows the new splice plates *e* in position clear from the backs of the channels and pins redriven, after which the new plates *e* are closed in to the backs of the channels, and 6 shows the pins again backed out and rivets driven in their place. The chords were made up of plates and angles, but to permit a clearer illustration, channels are shown in Fig. 4, and the top and bottom splice plates are not drawn.

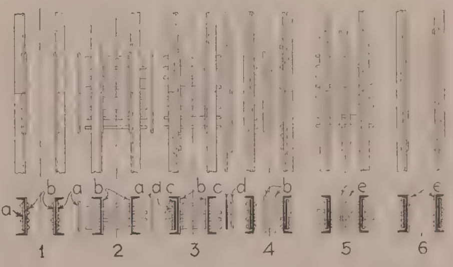


FIG. 4—SUCCESSIVE STEPS IN REINFORCING SPLICE IN CHORD

As shown in Fig. 3, false chords were employed to take up the horizontal components of the stresses in the saddles. The false chords, which were of long-leaf pine, were placed over the whole length of the chords and were secured by blocks and bolts as shown. The blocks of the saddles were of hard wood, the saddle rods being upset at the ends. Only such number of saddles and falst posts as were necessary for one operation were made, being moved as required. False chords were made for but one truss, and reset for the second truss.

APPROXIMATE RELATIVE COSTS

The method of relieving stress by eccentric ballast loading worked out with entire satisfaction, but a few minutes being required in any case to place or remove the ballast. No exact data were kept of the cost of material in the auxiliary members or of its manipulation, but an approximate estimate made up from general cost sheets indicated that the supporting members were made and manipulated at a cost of less than $800. A system of falsework could not have been constructed for less than $3,500.

The only objection that the writer can see to employing the methods described is that the chord and end-post members were under partial stress when the reinforcing plates were added to the section. The old metal was therefore of necessity stressed higher per unit of section than was the new metal when the work was completed and under full live and dead loads. This is not believed to be a serious objection, as stresses at the time that repairs were made were not more than 20 per cent of the stresses under full loads. The difference in unit stress between old and new metal was anticipated and provided for in the form of an increase in the section of new plates, so that the maximum stress in the old metal would not exceed a reasonable limit. The increase in new section to take care of the inequality of unit stresses was a small item in comparison with the saving effected by the elimination of centering.

The principle of supporting trusses without falsework has been adopted in several other cases, the details being changed when necessary to adapt it to different types of truss. In one instance several diagonals of a light country bridge were removed and replaced entirely by the aid of ballast loading.

It is hardly necessary to say that the methods described require a careful analysis of stresses and strength of members, a careful detail of supporting members and the constant attention of a competent bridge engineer.

Special Tile Holds Reinforcing in Storage Building

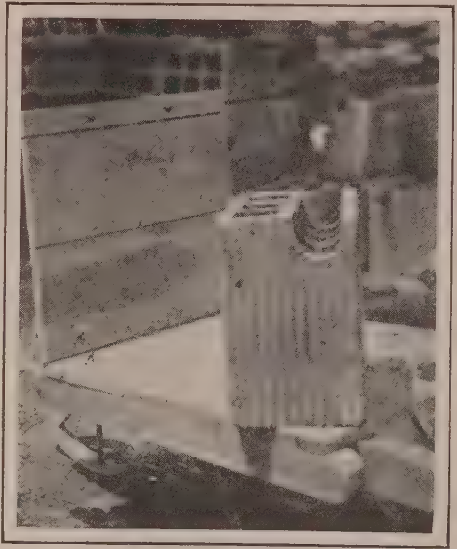
U-Shaped Grooves in Tile for Reinforcing Rods—Cost of Construction with Tile and Concrete Is Exceedingly Low

NEW construction methods have been used to reduce the cost of cottonseed storage buildings in the South. By using tile in which there is a U-shaped groove for holding reinforcing rods, the boiler plate originally specified was replaced at a saving in steel which reduced the construction cost to $3.50 per ton of material stored.

BUILDINGS ARE 75 FEET IN DIAMETER AND 60 FEET HIGH

The two buildings are each 75 ft. in diameter and 60 ft. high, having a total capacity of 7000 tons. The floor is of concrete. The foundation extends about 3 ft. below the surface, resting on heavy clay. The special construction of the tile is shown in the illustration. Corrugated steel bars placed in the U-groove are held in place with concrete. Wet, heavy cinders are placed in the tile to keep the concrete around the rods. In the first 25 ft. of tile two ½-in. bars are placed in the grooves; in the next 25 ft. a ⅝-in. bar is used. In the top 10 ft., ½-in. bars form the reinforcing. The bottom 10 ft. of wall has two thicknesses of tile, and above that point one thickness is used.

The cottonseed is put into the buildings at the center of the top, thus making a cone-shaped pile, tending to decrease the danger of the walls bulging out. An A-frame steel tunnel runs through the center on the bottom of each building, in which a conveyor will be placed to remove the seed.


SPECIAL TILE HOLDS REINFORCING IN U-SHAPED GROOVE

W. W. Griffin, of the Griffin Construction Company, Atlanta, Ga., the designer, is constructing two of this type of cottonseed storage buildings in Atlanta for the Buckeye Cotton Oil Company. Eight buildings of almost similar construction are being built for the Swift & Company's mill at Augusta.

Railway Income Continues Upward Climb in April

Gross operating revenues for April on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1,223 per mile, showing an increase of $210 or 20.8 per cent as compared with April, 1915. Operating expenses were $827, an increase of $103 or 14.3 per cent. Net operating revenue, therefore, was $396—an increase of $107 or 37.0 per cent, and operating income was $342—an increase of $102 or 42.3 per cent.

Brick Pavement Carries 4492 Vehicles a Day

Driveways at Pennsylvania Terminal in New York City Show Little Effect of Wear After Seven Years in Service

A TRAFFIC census taken over a seven-day period, from May 22 to 29, at the two driveways to the Pennsylvania Railroad terminal in New York City shows that an average of 4492 vehicles a day pass over the pavement at the Thirty-third Street entrance and 3384 over that at the Thirty-first Street entrance. The pavement was laid in 1910 and at the present time shows very little effect of wear.

OBSERVATIONS CONTINUOUS

The observations were taken under the direction of D. O. McComb for the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, and were continuous throughout the period between midnight May 22 and midnight May 29.

Attention was paid to the possible effect of special events on the accuracy of the traffic count as a true daily average. It was found, however, that in a city the size of New York the special event is the rule rather than the exception, and has much less effect on a traffic census of the kind than would be the case in a smaller city.

A feature of the census was the large proportion of taxicabs using the pavements. At Thirty-third Street 75 per cent of the vehicles were taxicabs.

All kinds of motor traffic spread out evenly over the driveways, while horse-drawn traffic kept close to the sides. The effect of the latter on the surface is noticeable at the curb, where a groove from ⅜ to ½ in. deep and about 2½ in. wide is worn into the pavement, caused by the locked wheels of the wagons going down the incline.

The traffic on the Thirty-first Street side is more diverse in character than that entering the Thirty-third Street entrance, the latter being principally taxicabs and the former carrying all the incoming baggage, express and only a small proportion of the passenger traffic.

167 TAXICABS IN AN HOUR

In one three-hour period, May 27, a total of 501 taxicabs entered the station—an average of 167 an hour. The average number of taxicabs a day reached 886, each passing twice over the pavement.

The count was taken of the vehicles going in. As these had to pass over the same road going out, the number was doubled to obtain the actual vehicular traffic passing over the roadway. The total daily vehicular traffic at the Thirty-first Street entrance was 3384 and that at the Thirty-third Street entrance 4492. The traffic at the Thirty-first Street entrance was constituted as follows: 42 rubber-tired carriages, 16 rubber-tired wagons, 700 steel-tired wagons, 1772 taxicabs, 617 automobiles and 236 motor trucks. That at Thirty-third Street was made up of 51 rubber-tired carriages, 417 steel-tired wagons, 3391 taxicabs, 496 automobiles and 135 motor trucks.

The pavement was laid in 1910, the bricks being bedded in cement mortar mixed 1:3. They are of fireclay made at Clearfield, Pa. On the inclines they are 7¼ x 2¼ and 2⅜ in., with beveled edges and no lugs. They were carefully laid and separated so that the mortar or grout could readily be placed in the joints.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

How Engineers Can Best Serve in the Mexican Emergency

SIR: I have been in receipt of numerous inquiries from engineers as to how their services could best be utilized in the present emergency along our southern border, and I have generally answered that the best service engineers can render at the present time is to join one of the engineer regiments of the National Guard, of which a large number must be raised to complete the engineer quota of the twelve infantry divisions of the National Guard.

I send this information to you thinking that it may be of interest to your readers.

W. M. BLACK,
Chief of Engineers, U. S. Army.
Washington, D. C.

Unprecedented Demand for Men

SIR: During the past winter and spring the demand for young men trained in technical schools has been unprecedented. Even during the winter months the call continued unabated, which is very unusual, because as a rule the demand is great only in the spring and summer months.

The civil engineering department of Lehigh University reports that between the dates of Sept. 1, 1915, and June 15, 1916, 119 companies or individuals asked for young men to fill either permanent positions or positions during the summer vacation of 1916. In all, these 119 applicants sent in requests for 392 men.

The accompanying table shows the principal branches of industry from which the applications came. For example, from twenty-one contractors and builders and others engaged in similar constructive work came applications for thirty-seven men at various times during the period under discussion. The young men wanted in this group were for the construction of buildings, both of the ordinary type and of concrete or steel, or they were wanted for the construction of various engineering works.

The table also shows that twenty-two manufacturing companies made requests for ninety-nine men, some of whom were desired for permanent positions and some for temporary work during the students' summer vacation. Under this class of companies are included those manufacturing steel, cement, castings, chemicals, machinery for handling materials, ventilating machinery and ammunition.

SUMMARY OF APPLICANTS FOR MEN

Types of industry	Number of companies applying for men	Number of men wanted
Machine shops	6	60
Manufacturing	22	99
Construction, including contracting and building	21	37
Valuation	7	81
Surveying	10	21
Engineering with railroads and other corporations	30	68
Engineering with consulting engineers	10	10
Teaching; high schools and colleges	8	8
Sales engineering	5	8
Total	119	392

Reference to the table shows that seven companies sought eighty-one men for making valuations and appraisals. Among these are included several railroad and telephone companies. The demand from railroads for assistants has been and is very great, and as the initial salaries paid by these corporations are generally small it is difficult at the present time to get young men to enter railroad service. Some of the applications shown in the table under the headings of surveying and valuation, as well as under engineering with railroads and other corporations, are from railroad companies.

A few of the larger railroad companies, finding it difficult and even impossible to secure assistants at the low salaries they were offering only a few months ago, have, in common with most other employers, increased the initial salaries for men just leaving college.

It appears that the present demand for young engineers may continue for a long period of time for three reasons:

1. Because of the prosperity in the United States.

2. Because many engineers trained in Europe and working in this country before the war started have left the United States, South America and Africa to enter military service in Europe. Moreover, the technical schools of Europe are not now in session, and have not been for about two years, and hence cannot supply young engineers for several years to come. American engineers will be called upon to do most of the engineering work of the Western Hemisphere without competition from men trained in the technical schools of Europe, as was the case before the present war.

3. Because about the years 1909 and 1910, when the supply of young engineers exceeded the demand, there was in general a material diminution in students entering civil engineering courses, in consequence of which classes graduating now are very small. This movement has probably gone too far, thus creating a shortage in the supply. The writer believes that as a result of the present scarcity of young engineers there will be a marked increase in the number of students entering civil-engineering courses during the next few years.

The average salary of the men graduating from the civil engineering department of Lehigh University in June, 1916, was between $75 and $80 per month at graduation. Among the employers of these men are to be found the New York State Highway Department, three bridge companies, several contractors, a company building coke plants, two railroad companies and several manufacturing plants. Most of the members of this class of 1916, possibly 90 per cent, desired to enter work on construction.

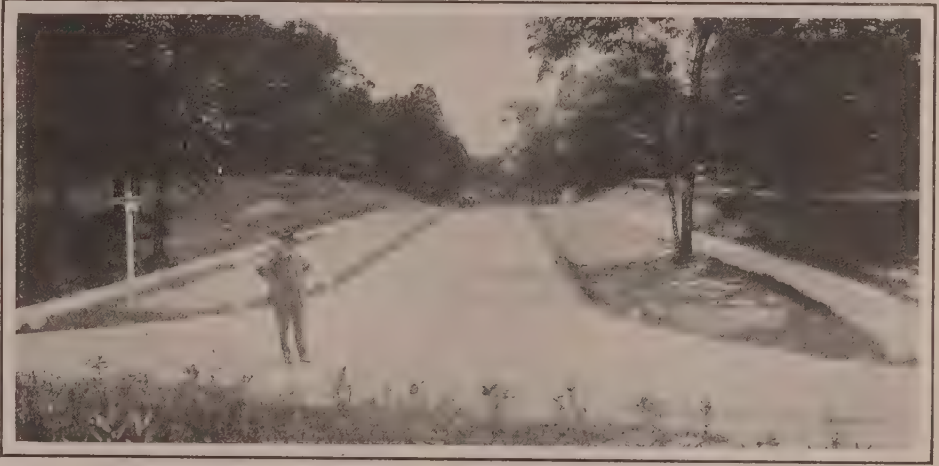
FRANK P. MCKIBBEN,
Professor of Civil Engineering, Lehigh University.
South Bethlehem, Pa.

Concrete Pavement 18 Feet Wide Has Inverted Crown

SIR: I am inclosing a photograph of street-paving work at Vernon Heights, Cedar Rapids, Iowa. The specifications on this work call for a 6-in. one-course concrete, mixed 1:2½:4.

The pavement has an inverted crown, is 18 ft. wide and is designed to carry the water in the center of the pavement. Inverted pavements of this type do not seem to be advocated very strongly, but the completed picture shows the advantage of an inverted pavement where no curb is used.

F. W. GREENE,
Resident Engineer, The Anderson Land Company.
Cedar Rapids, Iowa.



INVERTED CROWN FOUND EFFECTIVE FOR CONCRETE PAVEMENT WITH NO CURB

Proper Basis for Allocation of Maintenance Expenses

SIR: I have been very much interested in the article of Paul M. LaBach in your issue of May 13, 1916, page 639, regarding the proper basis for allocating railroad maintenance-of-way expenses. In these analyses he has called attention to two important points that I would like to emphasize:

1. The necessity for an accounting system that is so arranged with the analysis in mind that the necessary allocations may be reduced to a minimum. There are some accounts that from their nature have to be allocated. There are other accounts that under present conditions have to be allocated simply because the expenses applying to the two classes of service have not been

kept separate. One of the fundamental reasons for a classification of accounts is that it will make possible a suitable analysis of the cost of service. Therefore the requirements of the analysis should be kept clearly in mind in the arrangement of the classification, and suitable accounts should be provided to take care of expenses that are substantially different in their nature.

2. Mr. LaBach has not at all exaggerated the costs of maintaining the track and roadway that have nothing to do with the traffic carried. The smaller the road the greater is the proportion of the expenses that do not vary with the traffic handled.

The division of the maintenance-of-way expenses that do not vary with the traffic presents the greatest difficulty in the whole problem of the division between passenger and freight service. It does not seem logical to divide the expense equally between the two classes of service just because there are two kinds of service. In the case of a road where only one-tenth of the traffic is passenger and nine-tenths freight, a method that would charge half of these expenses to passenger and half to freight could surely not be justified.

To all intents and purposes these expenses are similar in their nature to the expenses due to the investment. The method that is suitable to assigning the investment and the expenses due to that investment, such as depreciation, taxes, renewals, etc., is best suited to the allocation of the maintenance-of-way expenses that do not vary with the traffic.

Having made this assumption as a starting point, the next step will be to determine the best method of assigning the investment in the track and roadway. I do not imagine that Mr. LaBach would be satisfied to assign the investment equally between the passenger and freight just because there are two classes of service. In the case referred to previously, where one-tenth of the traffic is passenger and nine-tenths freight, such a loading of the passenger traffic by assigning to each kind of service half of the investment in roadway and track would make impossible any payment of the costs by the passenger business, and would be unreasonable.

In order properly to assign investment or expense, the cause for that investment or expense must be found. When the cause is determined, then the assignment can be made intelligently. The promoters of a new railroad make detailed studies of the traffic that may be secured in the territory under contemplation. They make estimates of the amount of freight traffic and the amount of passenger traffic likely to develop. If the amount of the two combined traffics justifies the building of the railroad, the investment is made in the railroad in order to get the traffic. The traffic is the reason for the investment. Therefore the traffic in the two classes of service must be compared.

A common unit for the comparison of passenger and freight traffic involves the considerations not only of the physical units by which the traffic is handled, but also the income from the traffic, after the direct expenses of handling the traffic have been deducted from the gross earnings on that traffic.

The ton-mile is not altogether satisfactory as a unit for comparison of freight and passenger traffic, because in the passenger business it does not measure the service rendered. The train-mile is unsatisfactory because of the great difference in the relative values per unit.

In a recent analysis of an interurban electric property I made a study of the relative earnings per car-mile for passenger and for freight. In this special case the gross earnings per car-mile were found to be slightly more for freight than for passenger. But when the expense pertaining to each class of traffic was deducted from the gross earnings of that class, the amount remaining which can apply to the payment of the common expenses of maintenance-of-way, to the payment of taxes, fixed charges, etc., was found to be almost exactly the same per car-mile for passenger traffic as for freight traffic.

Under these conditions, then, there is no question that the car-mile is the best unit for the division of the investment in track and roadway between passenger and freight, of the expenses due to that investment and of the joint maintenance-of-way expenses not directly due to traffic.

Mr. LaBach's suggestion as to maximum loads or stresses being a better measure of the use of the railroad structure might very well apply to a certain part of the railroad structure, but its use would be limited to certain parts of the structure which are a comparatively small part of the total. For instance, if certain bridges had to be designed for high-speed passenger trains, the passenger traffic ought to be weighted with the difference between the cost of the structures as built and what the cost would be for slow-moving freight. But a refinement of this kind applies to such a small proportion of the total that there is danger of over-emphasizing the importance of it compared with the main question of the assignment of the property and expenses common to both classes.

John A. Rockwood.

Portland, Ore.

Present-Day College Education

Sir: Having read editorial contributions published in your paper of late on "Present-Day College Education," and having differed with some most decidedly—particularly the ten summary paragraphs of Professor Swain's reply to Professor Mead's criticism in the issue of May 6 and the communication of T. Chalkley Hatton in the issue of June 10—it is my motive to take issue with Mr. Hatton in his efforts to discredit college training of young engineers.

In a desire "to test the applicant's ability to interpret specifications in a common-sense and accurate manner" the examiner of candidates for positions as paving inspectors asked them to define the word "pacificist" and also to name the states bordering Mexico. Because one or two of these men happened to answer ridiculously Mr. Hatton concludes in his third paragraph that "certainly these young men had not attained that thoroughness and accuracy in their college education which fitted them to fill satisfactorily the simplest engineering positions. They were not taught to think straight."

"Not having a set of specifications at hand," it is stated, "the examiner, in order to test the applicant's ability to interpret specifications in a common-sense and accurate manner," asked such questions as the meaning of words and questions on geography. Who is the more ridiculous—the examiner or the examined? Was the examiner not testing the strength of their grammar-school training, and is it not illogical to conclude that this lack of knowledge was due to a deficiency to be laid at the door of the college? The examiner must have been very limited indeed if, for lack of specifications, he should be forced to ask such questions. Would not a few original problems in mathematics or mechanics, or a few questions as to the method of procedure they would adopt, given certain imaginary conditions arising in the field, or the like, have really tested the probability of their fitness "to interpret specifications in a common-sense and accurate manner"? It is not contended that the answers were pardonable, but those answers in no way affect a man's fitness as a paving inspector.

Another feature of Mr. Hatton's citing this incident is that he is willing and eager to attempt to drag a multitude of young engineers down to the level of one whose grammar-school education was found to be lacking.

Mr. Hatton says "they were not taught to think straight." Should a candidate answer a great number of that type of questions correctly, does that not indicate accuracy of *memory* rather than accuracy of *thought?*

Summit, N. J. Austin H. Reeves.

Pump Delivered Quickly for Camp Whitman Water Supply

Sir: It has occurred to us that it probably would be of interest to your readers to learn of the facility with which we were able to furnish the necessary pumping equipment for providing the soldiers at Camp Whitman, N. Y., with the necessary water supply.

On June 23 one of the officers of the Twenty-second Corps of Engineers telephoned our New York office requesting that one of our representatives come to Camp Whitman and confer with them regarding the pumping equipment which would be required.

The writer spent Saturday, June 24, at the camp, and, after going over the situation thoroughly, it was decided that a centrifugal pump, to deliver 325 gal. per minute against a total head of 230 ft. would meet their requirements in all respects.

I telephoned our shop, the American Well Works, Aurora, Ill., at about 2:30 or 3 p. m. on Saturday and arranged with them for the shipment of one of our No. 3½ type I belt-driven, two-stage, solid shell, open-impeller, centrifugal pumps. This pump was delivered to the camp officials at Poughkeepsie at about 9 p. m. Sunday, June 25, and, according to the newspaper report, reached Camp Whitman at Green Haven, N. Y., before daylight on Monday, June 26.

S. B. Whinery,

Eastern Sales Agent American Well Works,
New York City.

[This letter adds an interesting detail to the article, "With the 22d Corps of Engineers at Camp Whitman," published in the Engineering Record last week. From the information it contains it is apparent that the wells upon which reliance was placed for the camp supply did not meet expectations as to flow, and that the alternative source, noted in last week's article, Fishkill Creek, is being utilized. The water from this creek is being sterilized with liquid chlorine.—Editor.]

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Put Mixer on Roof to Add Eleventh Story

TO AVOID confusion on the street and in the basement of the ten-story department store of Rothschild & Co., in Chicago, the concrete for a portion of an additional story was mixed on the adjacent roof. The spectacle of a mixer far above ground grinding out concrete, with the Auditorium tower and the top of the Blackstone Hotel as a background, was more or less of a novelty. In getting the aggregate from the street to the mixer advantage was taken of portions of the coal-handling equipment and the freight elevator service.

The building was constructed several years ago and the modern steel frame was designed to carry additional stories when expansion became necessary. The additional story is at the south end, 176 ft. on State Street and 144 ft. on Van Buren Street. As the street walls extend a considerable distance above the existing roof it was only necessary to construct a new roof and floor, which required 14 columns, 95 beams and 22 girders, all of concrete. This work and the new roof were built before attempting to replace the old roof with a concrete floor.

The equipment of the building, in addition to an extensive passenger-elevator service, includes two large high-speed freight elevators, which travel from the third basement to the tenth floor. One of these elevators has a capacity of 10 tons. In the third basement are several elevator hoppers connected by chutes with the ground surface in the rear alley. The gates discharge coal for the furnaces into a traveling bucket. It was decided to use several of these hoppers for handling the sand and stone in the new construction work. Material was delivered in 6-ton auto trucks and dumped down the chutes into the hoppers, from which it was gated into wheelbarrows. The large elevator carried nine loaded wheelbarrows and the smaller one five to the tenth floor at each load. An inclined runway was built from the tenth floor to the roof, and all material used in the concrete and the new construction work was transported from the tenth floor up this runway.

On account of its light weight and portability the contractors used a motor-driven 8-ft. Standard low-charging mixer, which was taken up the large elevator to the tenth floor and then transported up the material runway to the roof.

The work was carried out by the Clark-Bisbee Company, of Chicago.

Accounting for the Contractor: Equipment Account

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company,
Scranton, Pa.

A LEDGER account may be kept for the portable equipment of each job, but ordinarily a more convenient method is to run only one account, which for the sake of brevity we will call "Plant." Portable plant, being shipped about from job to job, is rather difficult to keep track of unless some definite, easily operated system is employed. A card record supplies the simplest solution. Cards measuring 3 x 5 in. are the standard size, fitting the box files or drawer units handled by most dealers in office supplies. If economy demand that for a time such records be kept in a pigeonhole of the desk, or even in a pasteboard box, at least be sure a start is made with the proper-sized card, so that all the matter will not have to be rewritten later. Index cards can be procured with ¼-in. tabs.

To demonstrate, let us list the equipment of our fictitious friends Messrs. Arnold, Brown & Co. On the first tab will be written "Bridge No. 4," to indicate that the following cards serve to list the equipment on that job. Following out here the alphabetical idea, the first cards after the index card will read somewhat as shown in the accompanying samples. Others will follow till the list of equipment at Bridge No. 4 is complete.

BUCKET
1 Special No. 10—cost $90.00
Bought Aug. 1, 1914 of
Dayton Supply Co.
for Acton work
Transferred Jan. 5, 1915 to Portland
" Sept. 10, 1915 to Bridge No. 4

DERRICK
1 Stiff-leg, 22′ mast 38′ boom
Bought Sept. 1, 1915, second hand, of
Smith & Co. for $120.00
for Bridge No. 4

MIXER
1 Burke Gasoline Concrete Mixer
Bought Feb. 12, 1915, of D. E. Francis
for $800.00
for Portland work
Transferred Sept. 10, 1915 to Bridge No. 4

Then on the tab of another index card will be written "Corfu," and following that will come the cards descriptive of the Corfu plant, and so on till the entire plant is recorded and indexed. When additional equipment is purchased, the invoice or bill of sale will be approved, entered and filed as suggested in a previous article of this series, and charged to "Plant"; at the same time a descriptive card will be prepared and placed in the index. Now, when the Bridge No. 4 mixer is moved to the job at Leeds the card is moved along, too, after noting thereon the date on which the change was made.

The plant account should be kept at cost, until such time as a complete revaluation becomes necessary. In the meantime annual depreciation should be balanced by en-

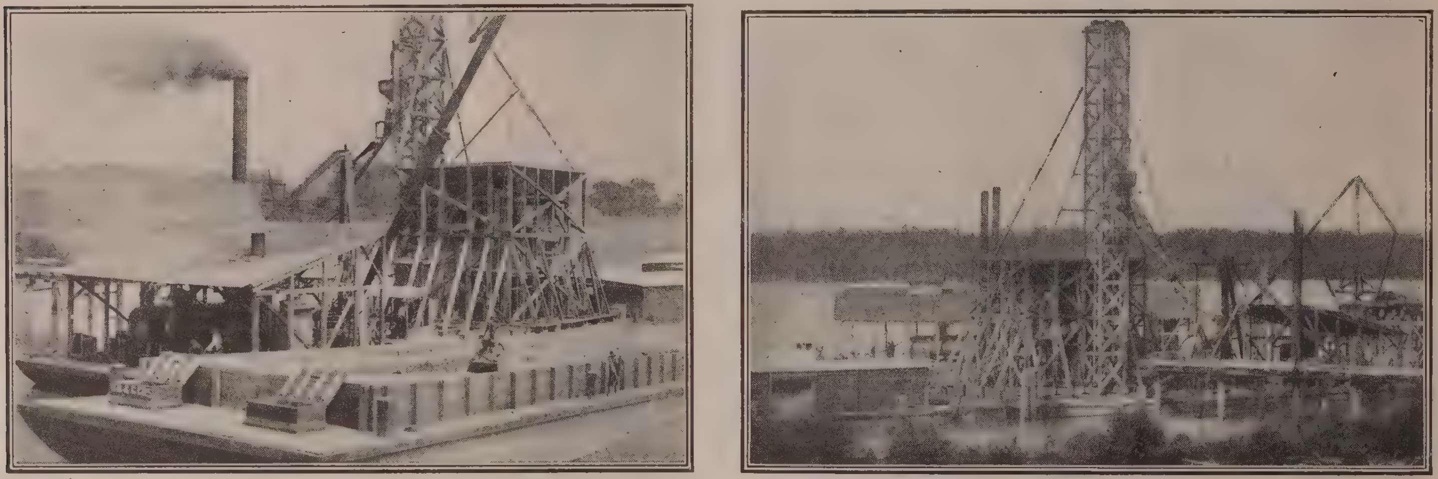
MIXER ON ADJOINING ROOF ADDS ELEVENTH STORY TO CHICAGO DEPARTMENT STORE WITHOUT INTERRUPTING BUSINESS ON FLOORS BELOW tries to the credit of "Reserve for Depreciation," as will be explained in a subsequent article.

Small tools, such as shovels, picks, crowbars, hand drills, etc., should not be carried in the plant account, but charged to the expense incident to each contract. Should there be any salvage at the conclusion of the job, the job can be given credit at an appraised valuation and a corresponding expense charge made against the next contract on which such tools or left-over supplies may be used.

Tower and Derrick on Same Boat in Concrete Plant for Bridge

By A. FREDERICKSON
Metropolis, Ill.

THE FLOATING mixing plant used to place concrete in the piers for the Paducah & Illinois bridge is fed by a derrick mounted on the same barge with the bins and distributing tower. The bins and 1-yd. mixer are set lengthwise on the barge, and the tower is located at one side of the deck at the center of the bins, instead of on the center line of the boat. The barge on which the plant is mounted is 36 x 110 ft., 5 ft. deep. The boat mounts a 75-ft. tower, and the swinging of a 1¼-yd. clamshell bucket loaded with gravel did not tip it enough to cause spilling in spouting concrete through the 2-ft. door of an air lock in sealing the caissons, although no hopper was used on the lock.



SWINGING OF LOADED CLAMSHELL BUCKET DOES NOT TIP MIXER BOAT ENOUGH TO DISTURB CHUTES EVEN WITH 75-FOOT TOWER

A 60-hp. boiler furnishes steam for the mixer, the two drum tower hoist, a dynamo engine, water pump and heating coils in the gravel hopper and water tank. One drum of the tower hoist is lagged with 3-in. hardwood for the bucket line, and the other drum is used for raising and lowering the tower hopper and boom. The shaft of the top drum is extended to the center of the barge, where a spool is mounted for pulling a self-dumping cement car to the charging platform from the cement barge. This car runs up an inclined track which has a removable extension into the cement barge. An independent three-drum hoist, boiler and swinging gear are used to operate the derrick. The photographs show the plant at pier 1 before the tower was equipped with a boom, and with only two chutes in use. The plant has placed more than 700 cu. yd. in a 12-hr. run.

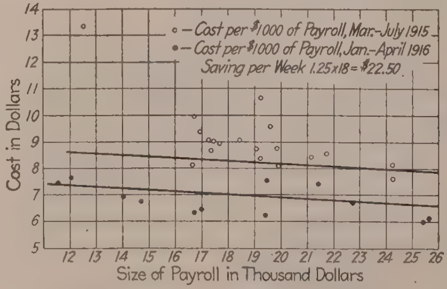
The plant was built for the work and was designed by H. K. Seltzer, chief engineer of the Union Bridge & Construction Co., contractor for the substructure of the bridge. G. F. Wilhelm and T. T. Newman are respectively engineer and superintendent for the contractor, while C. R. Fickes is resident engineer for the Paducah & Illinois Railroad Company, for which the bridge is being constructed.

Cost of Cost-Keeping Cut by Study of Office Force

By DAN PATCH
Aberthaw Construction Company, Boston

THE COST of making up payrolls and keeping construction costs in a common field office for several large jobs with which the writer was connected was greatly reduced during the last year. Most efficiency work is applied by the office or overhead force to the direct labor, or working force; but in the present interesting instance the work of a cost-keeping office itself was under observation. As the office was not under orders of the writer, all changes were made by suggestion to the office head, who fortunately was interested in the record of his office.

In order to follow the work of the office and stimulate interest, three curves were plotted on the weekly payroll dated as abscissæ. The first curve had as ordinates the total payroll for the week ending that date; the second, the pay of the members of the cost department; and the third, the quotient of the latter by the former expressed in dollars per thousand of payroll. Curves of this kind are not a cure, but are more like clinical temperature and pulse charts, indicative of the need of a cure or of the results of its application. Almost any device which stimulates interest and starts thinking processes will eventually bring increased efficiency.



INCREASING OFFICE EFFICIENCY

So it came about that men of the cost department were found to have training which fitted them for vacancies in the organization where the work was of more importance and more nearly commensurate with their pay. They were transferred and their places taken by younger and less broadly trained men. It also developed that by a slight change in arrangements considerable overtime on payrolls could be eliminated. All unncessary subdivisions of costs were excluded. It had been customary to enter all costs daily in the cost books. Thereafter only such costs as could be set against quantities of work and expressed in units were used daily. Each week a summary of the costs, checking with the payroll, was made up to send to the home office, and the method of making entries in the cost book was changed so that only those items on which the superintendents wished daily costs were entered daily, the others being entered weekly from the summary, as a bookkeeper would enter from his cash book to his ledger.

These changes may seem trivial, and because no stopwatch is mentioned may not seem to ring true to the gospel of scientific management; but the results were gratifying, as will be seen from the accompanying curves. In order to make the comparison shown in the diagram a fair one, two periods in which the payrolls fluctuated through about the same limits were taken from the clinical curve and the ordinates of cost per thousand of payroll plotted on abscissæ of thousands of payroll. A conservative estimate of the saving as shown by these points is $1.25 per thousand, and as the payroll was about $18,000, this meant about $22.50 per week. As the period through which the saving was made with this average payroll was thirty weeks, there was an aggregate saving of $675. It so happens that the concern for which the writer works does largely percentage work, and accordingly this saving actually reduced the company's earnings by $67 and netted the owners $742. This saving was accompanied by a reduction of one-half hour in the length of working day of the office force.

People sometimes wonder at the altruistic way in which doctors preach prevention as against cure, but here is a cold-blooded contractor following the example of the doctor. The answer is that profits made through waste are not normal, and that conservation eventually brings healthier conditions in business as well as in other things.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Testing Society Sends Standard Cement Specifications to Letter Ballot

Acceptance of Many Years' Conference Work by Committee C1 Marks Annual Meeting—Year Book to Be Replaced by Biennial Publication

The most animated of all the sessions at the annual meeting of the American Society for Testing Materials at Atlantic City last week was the Thursday morning discussion on cement and concrete. The report of Committee C1 recommending that the standard specifications for Portland cement, developed as a result of numerous conferences with committees of the American Society of Civil Engineers and the United States Government, should be accepted at once and submitted to letter ballot (to become effective Jan. 1, 1917, if adopted) was finally accepted. The recommendation that these standards be given the special name of "American Specifications and Methods of Tests for Portland Cement" was defeated.

Important action was taken on the recommendation of the executive committee when it was agreed to vote to replace the "Year Book" by a biennial publication to be called the "A. S. T. M. Standards." All tentative specifications are to be printed in the "Proceedings." This was ordered to be submitted to letter ballot.

Abstracts of the more important papers presented at the meeting will be found on pages 48 to 50 of this issue.

Report of Executive Committee

The executive committee reported that arrangements had been made with the U. S. Department of Commerce by which the standards of the society which bear upon export trade will be translated into foreign languages. All the 31 standards of Group 1 and 12 standards of Group 2 had been translated into Spanish by the middle of June.

The total membership of the society, including 210 junior members, is now 2071. This shows a greater increase than for any previous yearly period, even though the dues were increased 50 per cent at the beginning of the current fiscal year.

On the financial situation the report contained the following paragraph:

"From present indications it is to be anticipated that, barring expenditures in unexpected directions, the deficit of $6,407.03 at the beginning of the fiscal year will not only be extinguished, but will be converted into a moderate surplus by the end of the year, and that the financial affairs of the society will thereafter be on a thoroughly sound business basis for the first time in the history of the organization. The cash balance in the treasury June 1, 1916, was $15,666.86 with no unpaid bills, as compared with a cash balance of $6,480.79 at the corresponding period last year."

Specifications on Design

In connection with the question, submitted last year, whether engineering design and construction should form a part of any specifications, a new paragraph has been added to the regulations governing standing committees, as follows: "In the preparation of proposed standards, the consideration of matters of engineering design or construction shall not in general be regarded as falling within the province of the society. If, however, it should appear to a given committee that the consideration of such matters is, for special reasons, indispensable in specifications designed to cover the customary relations between the producers and consumers of a given product, then reference to such matter in proposed specifications for that product shall be permitted within the scope necessary for the particular purpose above stated."

To avoid danger of centered control a motion was passed instructing the executive committee to submit next year such changes in the by-laws as will make the appointed members of the nominating committee and of the executive committee ineligible for membership on the nominating committee for the next succeeding year.

Report of Committee on Steel

The recommendations of Committee A1, on steel, that certain requirements as to permissible variations in weight and thickness of structural steel in various standard specifications be changed, were approved and submitted to letter ballot. Six proposed tentative specifications for track spikes, screw spikes, tie plates, bars, etc., were adopted as tentative specifications.

Moving pictures of the methods used in the laboratory of the Pennsylvania Railroad for finding the yield point of steel specimens as obtained by the sudden change in the speed of the indicator of the Ames dial on the strain gage were shown. The total time required for one test obtaining yield point, ultimate strength and percentages of elongation and of contraction was given as 2½ min.

Committee A5, on corrosion of iron and steel, reported progress and also announced the enlargement of its field by the appointment of a subcommittee to investigate preservative metallic coatings for metals.

The following resolution was introduced by Dr. Henry M. Howe and was carried:

"Recognizing the confusion, inconvenience and loss of time and efficiency occasioned by the lack of uniformity in recording temperatures in this country; and recognizing further that the Centigrade scale is much simpler and more convenient than the Fahrenheit scale, and is the present standard in all countries except Great Britain, and is also in general use among scientific men throughout the world, be it

"Resolved, That it is the sense of this meeting that the efforts being made to obtain legislation requiring the use of the Centigrade scale in all future government publications should be heartily approved."

Yield Point and Elastic Limit

The report of Committee E1, on methods of testing, recommending the insertion of the proposed definitions of elastic limit, proportional limit and yield point, submitted last year, at the beginning of the methods for tension and compression tests, was approved and sent to letter ballot. The change recommended last year involving the determination of the modulus of elasticity was not recommended for adoption at this time. It will be further considered by subcommittees.

The topical discussion on the relation between yield point and proportional limit for various grades of steel was one of the most animated of the meeting. Following the formal papers by T. D. Lynch and H. F. Moore, both written and oral discussions were presented. In the oral discussion C. D. Young pointed out the difference between the relation

(Continued on page 60, column 2)

Plan Organization for Engineer Officers' Reserve

William Barclay Parsons, in Interview with Engineering Record Representative, Explains Tentative Scheme Based on Army Reorganization Act

In making definite provision for an engineer section of the Officers' Reserve Corps the Army Reorganization Act, which became effective July 1, furnishes a foundation upon which the War Department is preparing to build up a military organization of the nation's technically trained men. The new legislation deals with the engineer reserve corps only in general terms. Its main stipulations are that the engineer reserve corps shall be created, that its members shall be exempt from the age limits prescribed for officers in certain other branches of the active and reserve service (thus admitting to the rank of major men more than 45 years old), that commissions shall be issued by the President and be valid for a five-year term, that in time of war reserve officers may be called by the President to active service, with pay, and that in time of peace, if sums are appropriated, a fifteen-day period of field instruction each year may be prescribed. Beyond major provisions of this sort the act does not go. To the War Department, working in co-operation with a joint committee of civilian engineers, representing five of the national engineering societies, has been left the task of working out the details of the scheme. Although no final plan of organization has yet been adopted, William Barclay Parsons, chairman of the national joint committee, on which he represents the American Society of Civil Engineers, outlined to a representative of the Engineering Record this week the tentative scheme which the War Department now has under consideration.

Board Will Examine Candidates

At an early date the War Department will issue an invitation to the engineers of the country to apply for commissions in the reserve corps of engineers. To determine the qualifications of applicants there will be appointed a general examining board, consisting of officers from the Corps of Engineers of the Army and, probably, representatives of the five national engineering societies—civil, mining, mechanical, electrical and consulting—which co-operated with the War Department in the legislation affecting the Officers' Reserve Corps. The intention is to hold oral examinations at many places throughout the country where engineer officers are stationed, the civilian engineer members of the board aiding the army officers in reaching a correct estimate of the rank to which a candidate for a commission should be assigned.

Commissions are to be given for the grades of major, captain and lieutenant. It is likely that the requirements for major will be somewhat similar to those for "member" of the American Society of Civil Engineers, although actual membership in the American Society of Civil Engineers, or in any of the other national engineering organizations, will not be a requisite for a commission. The constitution of the American Society of Civil Engineers stipulates that a member shall be not less than 30 years of age, shall have been in active practice for 10 years, shall have had responsible charge of work for 5 years and shall be qualified to design as well as direct engineering work. Graduation from a school of engineering of recognized reputation is considered as equivalent to 2 years' active practice. With some slight revision—possibly an increase in the minimum age limit—these requirements, together with others based on military knowledge, may be the basis for the selection of majors in the reserve corps.

Technical Qualifications

As indicating what will be expected of a captain, the requirements of the American Society of Civil Engineers for an "associate member" will be followed in a general way. In the American Society an associate member must be 25 years old, have been in active practice for at least 6 years and have had responsible charge of work for at least 1 year.

A captain will need to be familiar also with drill regulations, field service regulations, etc.

Lieutenants will be recruited from the members of the profession who have qualifications somewhere between those of "junior" and "associate member" of the American Society.

The qualifications for major, captain and lieutenant, as outlined above, merely indicate in a general way what the War Department is considering. It is probable that some revision will be made in the age limits above referred to and that for its commissioned officers in the engineer section of the reserves the War Department will require men slightly older than those called for by the minimum in the several grades of the American Society of Civil Engineers. A man who combines technical with military experience will have this fact taken into consideration in his rating.

As to the size of the reserve corps no accurate prediction can be made. The Army Reorganization Act merely stipulates that the proportion of officers in the Officers' Reserve Corps shall not exceed the proportion for the same grade in the corresponding branch of the regular army, except that the number of commissioned officers in the lowest authorized grade shall not be limited.

The uniform of officers in the engineer section of the reserves will probably be the same as that in the regular army, except that the initials R. C. (Reserve Corps) will be superimposed upon the insignia of the castle which is the designation for engineer troops. The government will not furnish the officers' uniforms.

Mr. Parsons brought out the point that a commission in the Officers' Reserve Corps opens the way for those who wish to join the regular army. The new army act states that vacancies in the grade of second lieutenant are to be filled in the following order: (1) graduates of the U. S. Military Academy; (2) enlisted men whose fitness for promotion shall have been determined by competitive examinations; (3) members of the Officers' Reserve Corps between the ages of 21 and 27; (4) commissioned officers of the National Guard; (5) honor graduates of distinguished colleges entitled to preference by general orders of the War Department, and (6) candidates from civil life. It is thus seen that members of the Officers' Reserve Corps have the third preference for commissions in the regular army.

An Enlisted Reserve

The Army Reorganization Act also makes provision for an Enlisted Reserve Corps, and in the engineer section of this organization a particular effort is to be made to secure the enrollment of men qualified for the grade of "master engineer," which ranks somewhat higher than that of sergeant of infantry. This grade is designed to attract technically trained men to whom a sergeant's pay would not be an inducement. In this grade it is hoped to secure young men with National Guard experience, contractors' superintendents and foremen, expert draftsmen, etc.

The foregoing paragraphs give merely a sketch of the organization contemplated. The provisions outlined are subject to change. It is expected that the War Department will soon issue definite instructions regarding the formation of the Officers' Reserve Corps and the qualifications for admission.

Testing Society Sends Standard Cement Specifications to Letter Ballot

(Continued from page 59)

in question for the designer, who must fix working stresses, and for the testing engineer, who requires a rapid method of commercial testing for acceptance of material. It was also pointed out that a temperature test might be found useful in determining whether the strain is beyond the proportional limit or not.

Papers were presented by A. T. Goldbeck and E. B. Smith on an apparatus for determining soil pressures and by D. J. McAdam, Jr., on endurance and impact tests. These are abstracted on pages 48 and 49 of this issue.

Report of Committee C1 on Cement

The most animated session of the meeting occurred when the report of Committee C1, on cement, was presented. A new cement specification, which the committee desired to call the "American" specification, was proposed. Several changes from the form appearing in the preprint were reported. After prolonged debate the meeting refused to sanction the proposed title and referred the matter of titling to the executive committee. The specification was then passed to letter ballot, with the understanding that, if approved, it is to become effective Jan. 1, 1917.

Written discussions objecting to parts of the proposed standards were submitted by Benjamin A. Howes and by J. A. Kitts. It was pointed out, however, that some of the points to which objection was made had already been changed in the final draft.

The recommended tentative compression tests for mortar were ordered printed after some discussion of the change in test specimen from a cube to a 2-in. cylinder 4 in. long.

The committee has elected the following new officers: Chairman, R. S. Greenman; vice-chairmen, H. B. McFarland and John B. Lober; secretary, P. H. Bates.

Owing to the prolonged debate on the cement report, little time was available for the presentation of the papers on concrete. The more important points made in several of the papers will be found in the abstracts on another page of this issue. Discussing the paper by D. A. Abrams on rattler tests of concrete pavement specimens, G. P. Hemstreet outlined the results of more than a ten years' use of the rattler in testing asphalt paving blocks.

Ceramics

Committee C4, on clay and cement sewer pipes, presented again its "Schedule of Analytical Data for Sewer Pipe" and its tentative standards, entitled "Recommended Practice for the Laying of Sewer Pipe," with the request that, as amplified and expanded, these be again printed among the tentative standards. The meeting supported the recommendations of the committee.

Committee C6, on drain tile, reported proposed revised standard specifications, which differ from the present standards principally in the inclusion of absorption and freezing and thawing tests. The committee urged that these revisions be incorporated at once and that instead of printing the revised specifications as tentative for two years they be passed at once to letter ballot. The committee's recommendation was approved.

Road Materials and Timber

Committee D4, on road materials, proposed nine new standards or revisions of present standards, which were acted on as follows:

To Be Printed as Tentative Specifications for Two Years.—Tests for specific gravity, form of specifications for commercial grades of broken stone, method of determining softening point of bituminous materials other than tar products.

To Be Sent to Letter Ballot.—Method of making mechanical analysis of broken stone or broken slag; method for making mechanical analysis of mixtures of sand or other fine material with broken stone or broken slag; revised standard tests for loss on heating of oil and asphaltic compounds; revised standard method for making mechanical analysis of sand or other fine highway materials, except for fine aggregates used in cement concrete; method of test for distillation of bituminous materials suitable for road treatment.

The meeting concurred in the committee's recommendation that certain new definitions be published as tentative.

Committee C11, gypsum and gypsum products, withdrew the major part of its report, containing specifications. Definitions presented by the committee, however, were ordered printed as tentative.

Committee D7, on timber, presented specifications for Douglas fir and for sampling and analysis of creosote oil, which were ordered printed as tentative specifications. A specification was offered for wooden paving blocks, but was withdrawn by the committee.

At the closing session the secretary announced that the total registration for the meeting was 643; the men numbered 513 and the women 130. The registration at the 1915 meeting was 592—489 men and 103 women.

Kansas Engineering Committee Reports on Flood Prevention

The engineering committee of the Kansas Flood and Water Congress at a recent meeting at Topeka submitted a report in which it was stated that government aid will be necessary in effecting a satisfactory system for flood abatement in Kansas. The committee was also of the opinion that a permanent state flood commission should be appointed as the official body representing the state. The re-establishment of stream-gaging stations formerly maintained by the federal government and an exhaustive study of Kansas flood conditions were also recommended.

T. J. Strickler, state public utilities engineer and chairman of the committee, estimates the loss in Kansas during the past thirteen years due to floods at $52,000,000. He suggests state control to prevent plans for one drainage district from interfering with those of others.

New Jersey Water Commission Becomes Inoperative

Because of efficiency and economy legislation of last year the duties of the State Water Supply Commission of New Jersey have been assumed by the State Department of Conservation and Development. The geological bureau of the conservation department, which will hereafter handle the commission's work, proposes to make investigations of underground-water conditions in New Jersey and also determine what increase, if any, there has been in water-power development in that state during the past twenty-six years. Surveys will also be made to determine the safety of all dams in New Jersey.

Work on Twin Peaks Tunnel Progresses

That the Twin Peaks tunnel in San Francisco will be completed by June 1, 1917, is indicated by the progress of the work at the rate of 450 ft. a month. Concrete work has been practically completed at Laguna Honda Station, as well as from the west portal to that point.

A shaft has been sunk from the surface on the center line and considerably in advance of the heading, from the bottom of which drainage tunnels are being driven in both directions. As much as 300,000 gal. of water a day was pumped from this shaft at one time, although the flow is now about 160,000 gal. in twenty-four hours. To reduce the difficulties arising from excess water it is intended to advance the drainage headings until a junction is made with the main headings being driven from both directions.

Stuart Leaves Baltimore & Ohio; Begien Succeeds Him

General Superintendent of Southwestern Takes Place of Chief Engineer, Who Will Enter Private Practice

F. L. Stuart, chief engineer of the Baltimore & Ohio Railroad for the last five years, has resigned effective July 10, to engage in private engineering practice in New York City. R. N. Begien, general superintendent of the Baltimore & Ohio Southwestern, will succeed him.

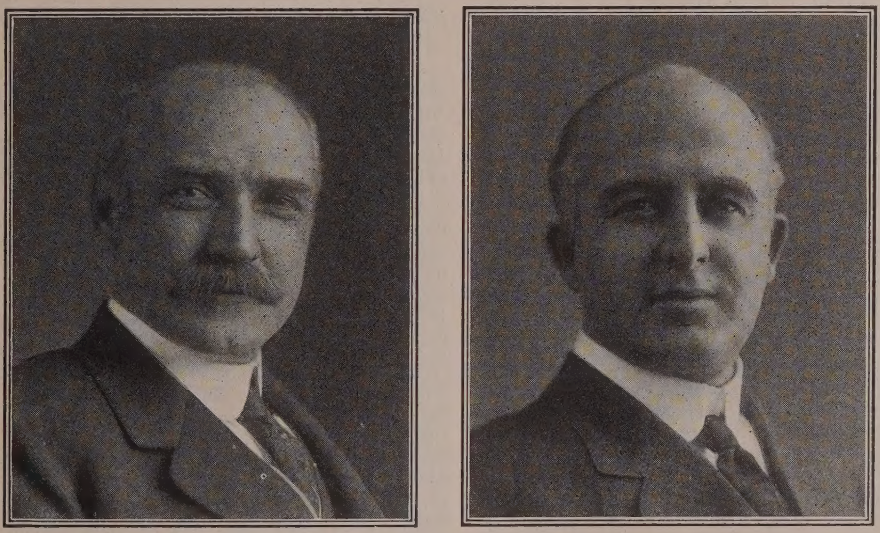
Francis Lee Stuart was born Dec. 6, 1866, at Camden, S. C., and was graduated from Emerson Institute, Washington, in 1884. That year he began railroad work with the Baltimore & Ohio. In 1887 he went to Alabama for the Cahaba Coal Mining Company, and from then until 1892 was engaged in various engineering work in the South. In the latter year he returned to the Baltimore & Ohio as resident engineer on construction work in Pennsylvania and West Virginia. He was engineer and contractor on various railways from 1895 to 1897, when he went to Nicaragua as assistant engineer of the Nicaragua Canal Commission, later being made division engineer of the Isthmian Canal Commission. In 1899 he returned to the Baltimore & Ohio as assistant engineer and in 1903 was advanced to district engineer, in charge of the development of grade reductions. The following year he was made engineer of surveys for the entire system. A year later he resigned to become chief engineer of the Erie and in 1911 again became connected with the Baltimore & Ohio as chief engineer, succeeding A. W. Thompson.

During these last five years, under Mr. Stuart's direction, the Baltimore & Ohio has undergone one of the most extensive programs of grade reduction ever put through by an American railroad. Two of the most noteworthy features were the Sand Patch tunnel and the Magnolia cutoff. A work that is at present attracting considerable attention is the low coal pier being built at Curtis Bay, near Baltimore—of a type quite different from anything now on the Atlantic seaboard. It is Mr. Stuart's intention to promote patents which he holds for conveying machinery to be used on this pier.

Ralph N. Begien was born in Boston in 1875 and was graduated from Harvard University in 1897. He also was with the Nicaragua Canal Commission for three years, after which he spent a year on railway work in Ecuador. In 1902 he began what has been a continuous service with the Baltimore & Ohio. Starting as assistant engineer, he was promoted to division engineer of the Philadelphia division in 1908. Early in 1910 he was made assistant to A. W. Thompson, then chief engineer. He remained as Mr. Thompson's assistant when at the end of that year Mr. Thompson was promoted to general manager, and again in May, 1912, when he was advanced to third vice-president. In December of the latter year, however, Mr. Begien was made assistant general superintendent of the main-line system, and a few months later was made general superintendent of the Baltimore & Ohio Southwestern.

Mr. Begien is a member and past chairman of the committee on economics of railway location of the American Railway Engineering Association, and has made some noteworthy investigations of train resistances and economic tonnages. He is also a director of the association.

Chief Engineer of Baltimore & Ohio Railroad Resigns—Succeeded by General Superintendent



FRANCIS L. STUART RALPH N. BEGIEN

California Road Commission Wants $15,000,000

The bond issue of $18,000,000 which the state of California voted for highway improvement in 1909 having been expended, the state highway commission has asked for a bond issue of $15,000,000 to be voted on next November. Of this amount $12,000,000 is wanted for the completion of the original system of trunk roads and county laterals; the remaining $3,000,000 is to be applied on a county-aid co-operative basis in building approved extensions which have been applied for by various counties.

The July issue of the *California Highway Bulletin* contains a map showing 1490 miles of road already constructed and indicating present conditions on the remainder of the 2900 miles which the highway commission has taken under consideration.

$16,119,583 Already Spent

The arrangement of the map is such that the importance of those sections of the proposed system which have been surveyed but for which funds are not available is apparent. It is pointed out that ex-Governor Gillett, under whose administration the original $18,000,000 issue was passed, has said: "I suggested that the first state good-roads bonds issue should be for only $18,000,000, not because I supposed for a moment that that amount would build all the roads or even all the state highways needed. I believed that if the sum of $18,000,000 was judiciously used the result would be to convince the people of the wisdom of good roads, and that whatever money was needed in the future the people would gladly give. I said that I thought it would take more than $5,000,000 to build the main trunk lines the state requires."

The commission's balance sheet shows that 87½ cents out of every dollar expended went directly into the roads. The other 12½ cents include all other expenditures, such as preliminary studies of mountain laterals and aid given to many counties.

The expenditure of $16,119,583 includes $14,468,082 for highways under construction, $181,400 for construction of plants and equipment, $745,044 for surveys and $725,057 for headquarters and division offices' general expense.

The remainder of $1,900,000 will be needed to complete roads already under contract and to build sections which the commission is obligated to construct.

Engineers to Make New York Depot Battalion Representative

Those New York engineers who have shown interest in the defense of this country from an engineering standpoint have, it is announced, an excellent opportunity to form a battalion representative of the profession in New York City by joining the depot organization being recruited by Major J. F. Fairchild at the armory of the 22d Regiment of Engineers, New York National Guard. Its depot battalion will consist of six companies recruited to 100 men or more each. Instruction in tactics and military engineering will be given. Each company will drill on a different night of the week, so that the men joining the battalion can practically select their drill night. The organization will be completely outfitted as engineer troops at the expense of the state and will serve for three years as state troops, or until the return of the regiment, when the members of the depot battalion will be mustered out, with the option of joining the 1st Regiment of Engineers, as the 22d is now designated by the War Department.

It is stated that enlistment will not interfere with attendance at Plattsburg camps or with the possibility of volunteering for federal service. Transfers to other state or federal military organizations can be arranged at any time.

More than 100 men of the Civilian Engineers' Training Battalion organized last March have already signified their intention of joining this organization, and it is expected that many of these men have had sufficient training already to enable them to qualify as noncommissioned officers. The executive committee of the Civilian Engineers' Training Battalion has expressed a wish that all of its members who are free to do so might join the depot organization because of the unusual opportunity to form the nucleus of a military engineering organization representative of the engineering profession in New York City.

An effort is being made both by this committee and by the recruiting authorities to enlist as many riggers, mechanics, foremen and construction men of all classes as possible in this organization in order to make it a standing example of the economy of giving military training to men with construction and engineering ability as against giving military engineering training to men without experience in either field.

Lima, Ohio, to Have Sewage Plant

Reinsch-Wurl screens and the activated-sludge treatments of sewage have been recommended for use at Lima, Ohio, by George W. Fuller, consulting engineer, of New York City. The screens are to be used during the entire year. The activated-sludge plant will be in operation seven months out of twelve at times when the flow of the Ottawa River is comparatively small.

Flood Deep Unbraced Coffer on Finishing Work

Completion of Excavation and Masonry for Forty-Sixth Street Pier, New York City. Occasion for Celebration

On the afternoon of July 1, after appropriate speeches by R. A. C. Smith, commissioner of docks and ferries, and John Purroy Mitchel, Mayor of New York City, the south flooding gate in the deep steel cofferdam for the shore section of the new Forty-sixth Street pier being constructed by the city was opened, flooding the slips cut out of rock 44 ft. below low tide. The cofferdam, inclosing an area 5½ acres, was described on page 68 of the Engineering Record of July 18, 1914, and on page 654 of the issue of May 22, 1915. Two leaks, one under the single row of sheeting at the north end and one under one of the large pockets at the lower end of the river arm, kept a 12-in. electric centrifugal pump running to half capacity. This dam is by far the driest one of its area built with one or more long sides against open water. The top of the cofferdam is said to have moved in 4 ft. since unwatering.

Handling of Construction

The 81,000 cu. yd. of rock excavated from the slips on either side of the pier were loaded by six locomotive cranes, on trestles at right angles to the river arm, into skips on cars, which, by means of steam dinkeys, were hauled along the river arm and out on to the end of the old Forty-fifth Street pile pier. Here the skips were dumped by locomotive cranes into scows. Concrete was mixed at a plant set on the river arm, described in the Engineering Record of Sept. 25, 1915, page 395. Much of it was spouted to place from the river arm of the coffer, while some was carried to the steel forms in buckets by the cranes and stiffleg derricks. The remainder was dumped into elevated hoppers, from which it was spouted to place. This last method is illustrated in the construction views shown on the opposite page.

A feature of the rock excavation was the method of shooting down a full-depth section of face, described on page 614 of the Engineering Record of Nov. 13, 1915. The most difficult part of this work was cleaning up the small shoulder of rock left under the banking along the river arm. When some of this banking was removed, a section of the coffer showed signs of instability, but the rock ledge was nevertheless excavated without accident. Heavy ice hampered the work of cleaning up the bottom for some weeks after the main excavation was well advanced and delayed the entire work. This ice, shown in one of the photographs, was as expensive to excavate as the rock and could not be thawed by any practicable means long enough to permit resumption of work.

Personnel

The design of the pier and the supervision of its construction have been carried out by the Department of Docks and Ferries of New York City, of which R. A. C. Smith is commissioner and C. W. Staniford chief engineer. The contractor for the work is the Holbrook, Cabot & Rollins Corporation, for which Thomas D. Bryson has been in general charge.

Pennsylvania Highway Forces Work on Roads Near Camp Brumbaugh

To assist the military forces of Pennsylvania in putting the roads around Camp Brumbaugh in good condition the State Highway Department has begun that work under the direction of W. D. Uhler, chief engineer of the department. Work was started June 30 with scrapers, rollers and other equipment. Caretakers in charge of drags will be stationed at the camp to keep the roads in the best possible condition.

Baltimore & Ohio Railroad Changes Its Districts

The Baltimore & Ohio Railroad June 28 made several important changes in the arrangement of its lines and in the jurisdiction of its executive officers. The system will hereafter be divided into three territories, to be known as the Eastern, Western and New York Terminal lines. The Eastern lines will embrace the main line and branches of the road east of Wheeling, W. Va., and Chicago Junction, Ohio. That part of the road west of Parkersburg, Wheeling and Chicago Junction will comprise the Western lines.

Among the changes in officers is included A. W. Thompson's promotion from third vice-president in charge of operation to vice-president in charge of traffic and commercial development, as announced elsewhere in this issue. The numerical order of designating vice-presidents has been discontinued.

$515,000 for Kansas City Levee Work Passed by City Council

The ordinance creating a district for flood protection in the East Bottoms in Kansas City became a law several months ago. Another bill providing for levee construction was passed by the city council last month and will be approved by the mayor.

The present plan favored by big property owners and manufacturers was drawn by Curtis Hill, city engineer. It withdraws all protection back on the shore line, is purely a flood-protection scheme and eliminates that part of a previous plan providing for the construction of dikes and revetment extending about 600 ft. out into the river.

In view of the change in plans eliminating the extension of the right bank of the Missouri River to the U. S. Harbor line, the federal government will not aid in the work. Flood district 1 has a total river frontage of 3.71 miles and covers about 2219 acres, of which 2092 are taxable for construction at the rate of $243 per acre.

Engineering Society Activities

The Connecticut State Association of Sanitary Engineers held its annual meeting recently at New Haven at which E. E. Thomas was elected president and O. T. Thomas, secretary and treasurer.

The Engineers Club of Seattle at the regular weekly meeting June 28 was entertained with the latest war news by "The Fighting Parson," Major John Pringle, D.S.O., Canadian Overseas Contingent. Major Pringle, who has just completed 10 months' continuous service, is on a short furlough.

The Providence Engineering Society, at its recent annual meeting, elected officers and took a trip over the site of the big $12,000,000 project under way at Kent. A dinner at the University Club completed the program. Thirty-five automobiles took 125 members of the society to Scituate. The business meeting was held in the Engineering Building of Brown University. Prof. J. Ansel Brooks, of Brown, was elected president. The other officers elected are: Vice-presidents, Ralph W. Adams, G. A. Carpenter, W. T. Robertson; corresponding secretary, A. E. Thornley; recording secretary, W. C. Kennedy; treasurer, A. E. Whatley; executive committee for three years, F. E. Winsor, Robert L. Brunet, W. C. Pickersgill and L. Earle Rowe.

The Detroit Engineering Society will hold its annual excursion and picnic to-day. The steamer Pleasure has been chartered and many kinds of entertainment have been arranged.

The Second National Exposition of Chemical Industries will be held in the Grand Central Palace, New York City, during the week of Sept. 25.

What Engineers and Contractors Are Doing

JUDSON R. WEST, chief engineer of the Seattle Port Commission since January, 1915, has resigned, effective July 31. Mr. West has accepted the chair of railroad engineering at the University of Pei Yang, Tientsin, China. Mr. West is a graduate of the University of Colorado and of the civil engineering department of the University of California. As the Port of Seattle's scheme of harbor development is practically completed and nearly all the engineering problems disposed of, Mr. West had expected to sever connections with the port during the summer. As professor of railroad engineering Mr. West will have one of the largest departments in the University of Pei Yang.

ROY WELSH, of Centralia, Wash., has been appointed city engineer of that city to succeed Caleb Berry, who resigned recently.

FRANK B. BLACK, member of the State Commission of Agriculture, has been made highway commissioner for Pennsylvania to succeed R. J. Cunningham, who died recently. Mr. Blake is a business man. His first public office was with the agricultural commission.

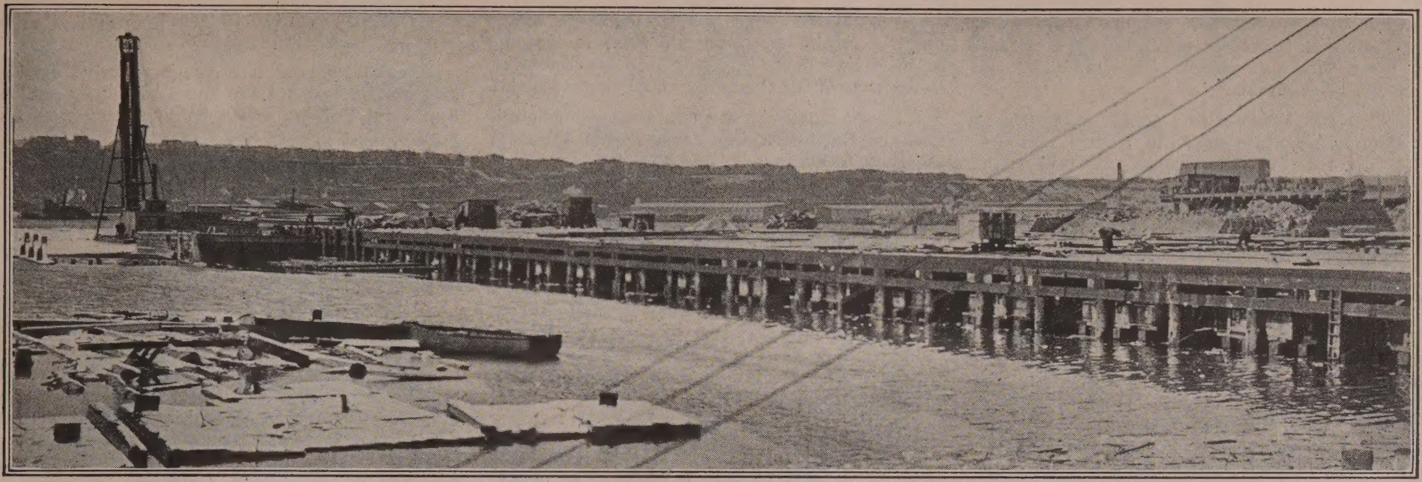
H. C. SMITH has resigned as engineering instructor at the University of Oklahoma to become associated with D. W. Patton, consulting civil engineer, of Poteau, Okla. Mr. Smith is a graduate of the University of Michigan. He and Mr. Patton will devote their time to highway, railroad and waterworks engineering.

WILEY RODMAN has been promoted from chief bridge engineer in the Kentucky department of roads to state commissioner of roads, succeeding R. C. Terrell. Mr. Rodman was graduated from the State College of Kentucky in 1906, and from June to October of that year was employed by H. L. Cooper as draftsman on preliminary work on the hydroelectric development at Keokuk, Iowa. He left that work to become assistant engineer for Viele, Blackwell & Buck, consulting engineers, of New York City, on the hydroelectric development at Oroville, Cal. In 1909 he was made engineer and superintendent of construction for the Livermore (Cal.) Water & Power Company and a year later went to the Hydraulic Engineering Company of Maine on work at Keokuk. He went to Mexico in 1912 in charge of shaft driving and tunnel work for the Mexican Light & Power Company and later in that year was made tunnel superintendent for that company under Jacobs & Davies, consulting engineers, of New York City. He has been with the Kentucky roads department since 1914.

A. R. MURPHY, of Knoxville, Tenn., has become associated with the engineering department of Wallace & Tiernan Company, New York City. Mr. Murphy was graduated from the University of Tennessee in 1907 and immediately became connected with the C. W. Hunt Company, New York City. In 1908 he was made draftsman and engineer in the Bureau of Municipal Research, New York City. He returned to his alma mater in 1909 to become fellow and instructor in civil engineering. He later became connected with the engineering department, Pitometer Company, New York City.

W. H. FRANKLIN has left the valuation department of the Chicago, Milwaukee & St. Paul Railway to join the construction forces of the James Black Masonry & Construction Company at Seattle, Wash.

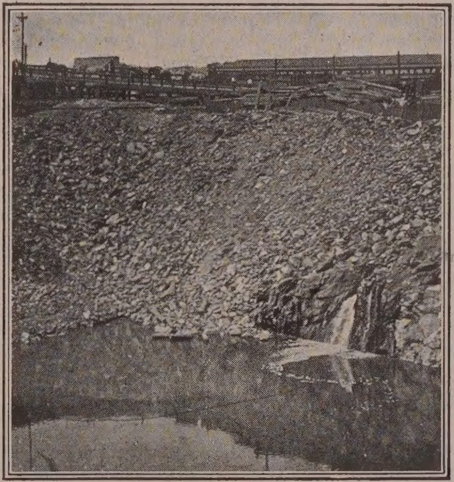
CHARLES P. LIGHT, field secretary of the American Highway Association and a prominent figure at highway conventions for many years, has resigned in order to form the firm of Graham & Light, which has been appointed district agent for the Fidelity Mutual Life Insurance Company, of Philadelphia. The



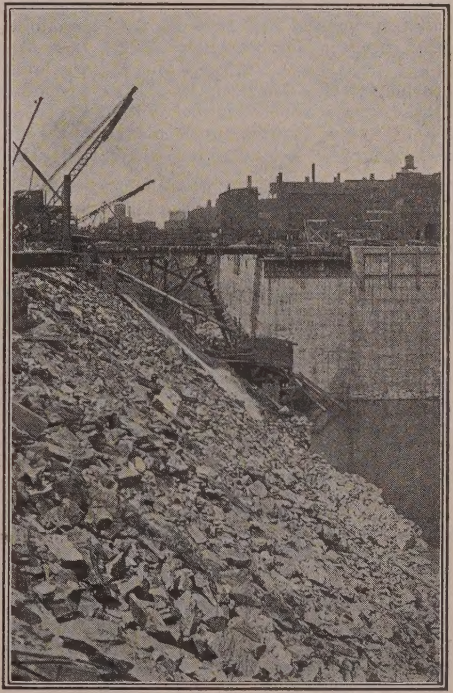
COMPLETING THE OUTER PILE SECTION

Deepest Unbraced Coffer, Built for New York Pier, Is Flooded After Serving with Great Success

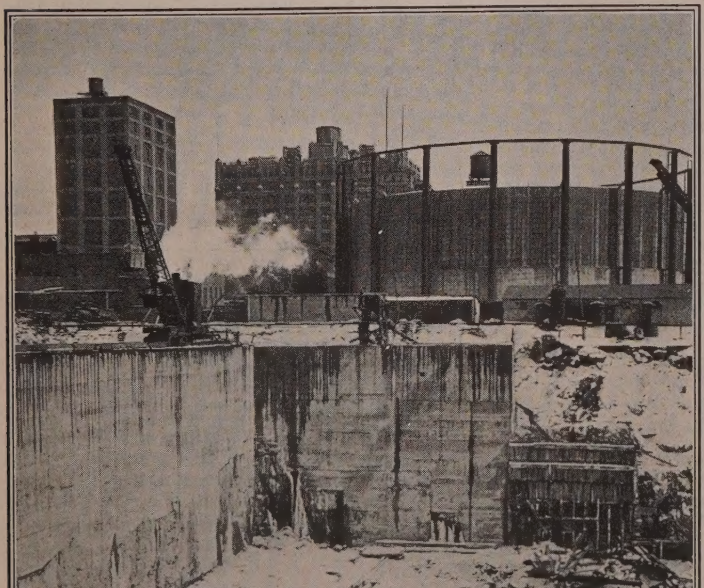
RAISING GATE TO FLOOD COFFER

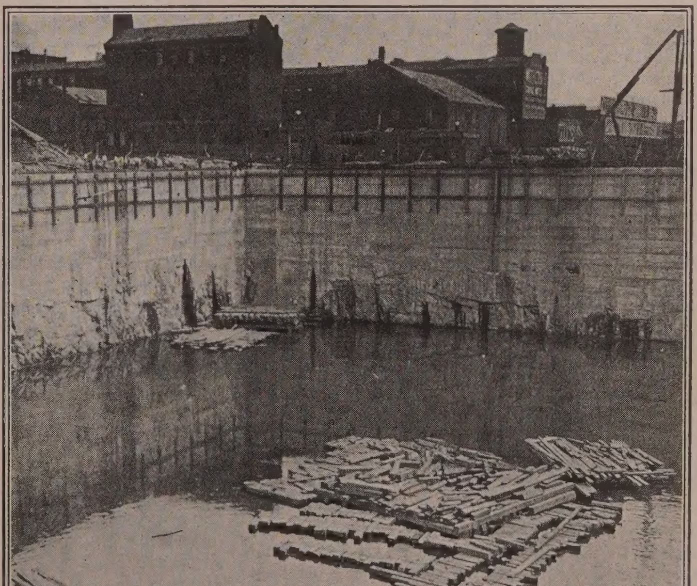


LARGER OF THE ONLY TWO LEAKS



TAKING OUT PUMP AS WATER ENTERS





WHILE ICE DELAYED CLEANING UP SLIP FLOORS, WALLS WERE CONCRETED—LESS THAN 4 INCHES OF WATER ON LEVEL SLIP FLOOR BEFORE FLOODING headquarters of the firm are in Washington, D. C., and its territory covers the greater part of West Virginia, western Maryland and the District of Columbia.

Jerome Newman, chief engineer of the California State Board of Harbor Commissioners since 1912, has resigned, to take effect as soon as a successor can be named. Mr. Newman is a graduate of the University of California, class of 1883. He spent three years at the Royal Polytechnic School, Charlottenburg, Prussia, doing post-graduate work, after which he entered the engineering department of the Southern Pacific Railway. He left the employ of that company in 1888 to take up land surveys, but again entered the railroad field in 1890 as resident engineer for the Northern Pacific Railroad. From June to October, 1894, he was topographer on the Overhead Pacific Railroad, which was never built. He became connected with the engineering department of the San Francisco & San Joaquin Valley Railway in 1895, where he was employed until 1900, when he was made office assistant to the chief engineer of the Southern Pacific. In 1904 he was appointed office engineer for the San Pedro, Los Angeles & Salt Lake Railroad and a year later returned to the Southern Pacific as assistant engineer, where he remained, with the exception of a few months, until his appointment to the board of harbor commissioners in 1912.

M. A. Howe has resigned as professor of civil engineering at the Rose Polytechnic Institute and will make his home in Vermont. Professor Howe has been a member of the faculty of the Rose Polytechnic Institute for twenty-nine years. At the farewell dinner given recently in his honor by the members of the board of direction and the faculty of the institute Professor Howe was made professor emeritus in civil engineering for life.

F. F. Hanly, formerly assistant engineer for the Baltimore & Ohio Railroad at Baltimore, has been made division engineer, with headquarters at Cumberland, Md.

J. S. Jones was recently elected president of the Wisconsin & Northern Railroad. His headquarters are in the Steger Building, Chicago.

E. V. Smith has been promoted from district engineer maintenance of way of the Baltimore & Ohio Railroad to assistant superintendent at Newcastle, Pa.

Major George R. Spalding, Corps of Engineers, U. S. A., has been transferred from Cincinnati to Louisville. Major Spalding's work at Cincinnati consisted of the general improvement of the Ohio River. At Louisville he succeeds Major Oakes, whose transfer to Philadelphia was noted in the June 17 issue.

Major Robert R. Ralston, Corps of Engineers, U. S. A., who has been in charge of the second Cincinnati district, will succeed Major Spalding in charge of the first Cincinnati district. Due to a change in plans, he will not be transferred to Louisville, as announced in the June 17 issue.

Ernest Stenger has resigned as general manager of the St. Joseph & Grand Island Railway to become general superintendent of the Union Pacific Railroad. Mr. Stenger was graduated from the University of Michigan in 1886. He entered railway service that year as rodman for the Burlington & Missouri River Railroad and in 1888 was made draftsman for the Atchison, Topeka & Santa Fé Railway. He remained with that road for two years, but in 1890 was appointed assistant engineer of the Missouri Pacific Railway. In 1900 he became division engineer of the Union Pacific Railroad and during his seven years' service with that company rose to the position of superintendent. He was made general superintendent of the Rio Grande Western Railway in 1907 and four years later became general manager of the St. Joseph & Grand Island Railway.

L. E. McDougal has closed his engineering offices in Imperial, Cal., to become connected with the engineering department of the Standard Oil Company at El Segundo, Cal.

Richard K. Meade, consulting engineer, of Baltimore, has removed his offices to the Law Building.

P. D. Fitzpatrick has been made general roadmaster of the Central Vermont Railway, with headquarters at St. Albans, Vt. The new work is in addition to his duties as valuation engineer for that railroad.

C. R. Knowles has been promoted from general foreman of waterworks of the Illinois Central and the Yazoo & Mississippi Valley railroads to superintendent of water service, with headquarters at Chicago.

James E. Jenkins has resigned as superintendent for Willard Case & Company, New York City, to take a position as superintendent on the construction of a concrete warehouse for the John W. Cowper Company, of Buffalo. Mr. Jenkins was graduated from the Rensselaer Polytechnic Institute in 1904. Previous to entering college he had seven years' experience on hydroelectric and deep-water surveys. After graduation he became connected with the Pennsylvania Railroad on the tunnel work under the East River at New York City. Early in 1907 he was made engineer for the Naughton Company and Arthur McMullen, contractors on sections A and B of the tunnels mentioned. He was appointed engineer for the Thomas Crimmins Contracting Company in 1908 in charge of work on the New York State Barge Canal. Three years later he took a similar position with Smith, Hauser & Company & Locher on a contract with the Board of Water Supply, New York City. In 1914 he was made chief engineer for the Union (S. C.) Manufacturing & Power Company and a year later took charge of the work on the Montreal aqueduct enlargement for the Cook Construction Company. He was later made superintendent for Willard Case & Company.

R. W. Reed, formerly with the engineering firm of Reed & Reed, Michigan City and East Chicago, Ind., is now superintendent for the Great Lakes Dredge & Dock Company at Buffalo.

Gilbert G. Hall, city and consulting engineer of South Bend, Wash., has been made a member of the Washington subcommittee of the Naval Advisory Board to obtain data on Washington industries

William Trapnell, formerly division engineer maintenance of way of the Baltimore & Ohio Railroad at Cumberland, has been made district engineer maintenance of way at Wheeling, W. Va.

W. W. Peterson has just been graduated from the civil engineering department of the University of Minnesota and is now employed in the engineering department of the city of Minot, N. D.

W. R. Sauter, formerly reinforced-concrete engineer for the Department of Wharves, Docks and Ferries of Philadelphia, has been made concrete engineer for Cramp & Company, contractors of that city.

H. Hudson has resigned as assistant city engineer of La Porte, Ind., to become connected with the Indiana Concrete Road Association, with headquarters at Indianapolis.

D. N. Showalter, formerly resident engineer on the reconstruction of the Stony River Dams in West Virginia, has purchased the planing mill at West Chester, Pa., formerly owned by S. C. Black. Mr. Showalter is a graduate of Lehigh University and has been engaged in construction engineering for the past ten years.

George W. Fuller, consulting engineer, of New York City, will give lectures on sanitary engineering during 1916-17 at Yale University. Mr. Fuller has also been made supervising engineer of the operation of the sewage-disposal tank at York, Pa.

G. L. Marick has been appointed assistant office engineer for the Gulf, Colorado & Santa Fé Railway, with headquarters at Galveston, Tex.

M. P. Mellon, formerly chief field engineer for the Tennessee Coal, Iron & Railroad Company, is now connected with R. G. Hill & Company, contractors, Birmingham, Ala. He is at present engaged in making a survey for 32 miles of road for which his company has the contract.

H. R. Hershey, who has been with the Pennsylvania Highway Department for the past ten years, has been made road superintendent of Lehigh and Northampton counties. Mr. Hershey entered the highway department as rodman and was successively transitman, chief of party and chief of construction. He succeeds W. H. Pascoe, resigned.

Arthur A. Prendergast, who has been employed for the past six months as assistant engineer in the department of public utilities on the design of the new coagulation basins and covered high-service reservoir for the city of St. Paul, has resigned to become superintendent of construction for the W. J. Hay Company of that city. The Hay company was recently awarded the contract for the construction of the coagulation basins. Mr. Prendergast is a graduate of the department of civil engineering of the University of Minnesota and for the five years previous to his employment by the city of St. Paul was superintendent of construction for the U. S. Reclamation Service. Previous to that he was connected with the Great Northern Railroad on construction and location and was superintendent of construction for Donald Grant & Company.

Obituary Notes

Frank J. Conlon, assistant engineer in the Bureau of Sewers, Brooklyn, N. Y., died June 28 at the age of 45. He has been connected with the bureau since 1895, previous to which he worked for his father on building erection for seven years. He started as draftsman in the sewer department and rose to be chief draftsman in 1900. He was made assistant engineer in 1905. Mr. Conlon has drawn plans for and superintended sewer work involving the expenditure of more than $10,000,000. Among his important works are the design of the sanitary sewer system for Coney Island and the contract plan and specifications for a number of branches of the Classon Avenue relief system.

S. H. Berry, county engineer for Kitsap County, Washington, died recently at Bremerton, Wash. He had lived in that city for about twenty years and for a long time was city engineer.

Civil Service Examinations

United States.—Examinations will be held Aug. 1 at the usual places for topographer with International Boundary Commission at $2,100 a year. Applicants should ask for Form 1312.

Illinois.—Examinations will be held Aug. 5 for assistant sanitary engineer at $100 to $225 a month. Candidates will not assemble for first examination, which will be written; those passing will then be assembled for oral review.

Examinations Previously Announced

Date		See Eng. Record
July 15	New York. Bridge designer, superintendent of construction and junior assistant engineer	July 1
Aug. 21-25	Second Lieutenant, civilian candidates	April 1